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PROGRESS IN ENGINEERING EDUCATION.

The dedication, on October 19, of a magnificent new engineering building at the University of Pennsylvania is an important event in the educational world. This building provides excellent facilities for instruction in all branches of engineering, and in its arrangement particular attention has been paid to the various laboratories, for without satisfactory equipment in these departments it is difficult, if not impossible, to give adequate instruction to the students. The engineering departments of the University of Pennsylvania are to be congratulated on acquiring such an excellent educational equipment, and one befitting the dignity of the university. Fortunately, such dedications have not been rare during the last few years, as nearly all the large universities have come to see the importance of providing thorough training in all branches of engineering, and a goodly number of them have already dedicated magnificent halls to training young men for the engineering profession, including its various branches.

The increasing attention which is being given to technical and scientific instruction is not without significance. It shows that the faculties of our universities now realize that it is their duty to provide instruction for that ever-increasing class of students who desire to acquire useful information at the same time they are training their minds. The demand for technical education shows that many of these men enter college with a definite purpose; yet there are others who have not finally decided to take up engineering as a profession, and who take instruction in some branch of it as a matter of preference. And it is also true that some of those who expect to become practising engineers drift into other lines of work, and experience has shown that this kind of training is well adapted to fitting men for walks in life, entrance to which is gained usually through other gates.

The last century was noteworthy on account of the remarkable development of the school systems and the general spread of education. It is not unlikely that the present century will be as remarkable on account of a similar spread of higher education, and in this it seems certain that the so-called technical courses will play a most important part. The young man who formerly could not afford to go to college because of the time it required will find means to do so, because the work he does there will be directly useful to him in his after life; and many others who to-day believe that they can not spare the time will then think that this time is well spent. The condition to-day marks the passing of the old idea that the best mental training a man could get was by wrestling with subjects that

had no interest for him and were of no practical value. To-day the opinion which is gaining rapidly is that while all mental exercise is good, and so far as developing the mind only is concerned equally good, the fact that the subject studied may be directly useful does not detract from its educational value. The present century will undoubtedly be marked by a spread of technical training and, as a result, a general advance in all our standards of education.

SEEING ELECTRICALLY.

Some little discussion has taken place recently regarding the possibilities of "seeing electrically." The idea of transmitting pictures is probably as old as the telephone, but a new interest in the matter has been aroused, apparently because two inventors have almost simultaneously claimed to have solved the problem. As yet no proofs have been submitted to show the validity of these claims, and until this has been done no one should be criticized for doubting.

The expression "seeing electrically" must be distinguished from another and simpler problem in the same field—that of transmitting pictures over a wire. The latter problem has been solved in various ways; in fact one solution is offered by the Gray telautograph, while Korn, in Austria, as well as others, have devised means for transmitting over a telegraph wire a passable reproduction of a photograph or drawing. These systems can not, however, be designated as means for seeing electrically, as the reproduction requires time for producing, and is built up painfully step by step.

To reproduce a visual image by electrical means is a problem more nearly resembling the transmission of speech than any other, but there is this great difference: in the transmission of speech a great variety of sensations is produced, but they occur one at a time, although they may follow one another with great rapidity. But to see electrically one must produce a large number of sensations simultaneously. This feature would make the solution seem hopeless were it not for the persistence of vision, on account of which, if the sensations succeed one another with sufficient rapidity, they seem to be simultaneous. If, therefore, the whole series of sensations can be caused to take place and the series start afresh before the first one of the series has died away, the image will appear permanent.

Another necessity for visual reproduction is some apparatus or material which will respond to light. Such a material is available. Selenium, an element of the sulphur group, when carefully prepared and cooled so as to crystallize in a certain way, becomes an electrical conductor whose resistance is affected by incident light. This material then might be used to vary an electrical current or a series of electrical currents sent out over a wire, so as to correspond to different intensities of light; and these currents might be caused to vary the illumination at the receiving end of the wire so as to reproduce there a similar effect. Suppose the object to be reproduced were a photographic positive plate and light were allowed to fall through this upon a sensitive selenium surface, reproducing there a picture of the object in lights and shades. If the selenium surface were divided into a large number of small squares, each of these would represent a small portion of the object, just as do the small squares of a half-tone. If, from each one of these squares, a wire be led out and equal sources of electromotive force be introduced into them, the currents flowing will correspond in a way, to the average intensity of the light on the corresponding squares, on account of the effect of the light upon the selenium. These various currents could then be caused to reproduce the original image by determining the amount of illumination which should fall upon the corresponding squares of the receiving surface, but there would be this difference: the illumination of each little square on the receiving surface would be uniform, so that the final picture would be built up of a large number of small squares all differing from one another, but each one uniform in itself. The image would resemble very closely a half-tone reproduction.

For any satisfactory reproduction these little squares should be small—that is to say, there should be a large number of them; but this introduces a difficulty, for assuming each one to be one-fiftieth of an inch on a side, which would correspond to a very coarse half-tone screen, there would be 2,500 squares to each square inch of picture, and it is, of course, out of the question to carry any such number of wires as this arrangement would require any considerable distance to reproduce a picture. To get around this difficulty the impressions might be produced successively with sufficient speed. To do this requires that two different mechanisms, one at the transmitting station and one at the receiving station, run in almost absolute synchronism; but that may not be impossible. Assuming, however, that the same degree of subdivision be adhered to, and the image produced is about four inches square, it will be necessary to transmit 100,000 impressions per second, if each impression persists for only one-tenth of a second. To do this is certainly not easy, for it requires apparatus at the receiving end which will respond to this rapid change. Given such a device, and supposing that the selenium itself would respond to the action of the light with sufficient rapidity, a small spot of light might be caused to travel rapidly over the selenium screen, and the changes in the resistance thus caused be made to vary the intensity of a second spot of light which is following exactly on the receiving surface the motions of the transmitting spot. If this could be done satisfactorily the result would be a picture on the receiving surface resembling a half-tone reproduction. At the present time we seem to be a long way from accomplishing this result. We have developed part of the necessary equipment, but little or no progress has been shown to have been made in constructing a practical apparatus; and although the plan outlined was suggested some time ago, we seem to be no nearer to the solution than we were before.

The problem is thus seen to be a very difficult one. It is much more difficult than transmitting speech, because of the large number of simultaneous sensations which must be reproduced, and this applies to the reproduction of only a simple black and white picture. To reproduce an image of the original object in its original colors seems to be as difficult again, as this

introduces a new factor. Not only must we cause a variation in the intensity of illumination, but in the character of the sensation produced, and as yet we have discovered nothing which will respond in different ways to different colors of light. When it is realized that even the so-called systems of photographing in colors do not actually do this, and that the colors of the reproduction are added, and not reproduced, the probability that any one has to-day succeeded in transmitting electrically a picture in its natural color would seem to be very remote.

OIL-ELECTRIC BOATS.

The advantages of interposing a dynamo and a motor between the prime mover and the driven wheels have led to the adaptation of this system for vehicle propulsion. A number of automobiles have been equipped in this way which undoubtedly possesses some virtues, and a similar arrangement is now being tried both in this country and in Europe for propelling cars on railways. A further extension of this principle has been taken by the application of it to ship propulsion, for which purpose it possesses features of considerable importance. Economy of fuel, of space and of weight is an essential to success in marine engineering, so that the oil engine which does away with boilers and which gives a remarkably high thermal efficiency offers a possibility of making an important development in marine engineering if it can be applied satisfactorily. Unfortunately, these engines are generally irreversible, and they do not submit readily to speed control. Moreover, they can not be started under load. These features are, however, essential in marine work, so that to apply the oil engine to propelling boats requires the introduction of some system of transmission between the engine and propeller which will make up for the deficiencies of the engine; and here electrical transmission has stepped in, for by attaching a generator to the engine and a motor to the propeller shaft, the desired flexibility is obtained.

This plan is, of course, not perfect, for the introduction of the two new mechanisms offsets, in part at least, the displacing of the boilers. But the high efficiency of the oil engine still remains, and even when coupled with the necessary electrical losses may give a resultant efficiency still above that obtainable with the steam engine. And the system brings with it other advantages not obtainable in any other way. The engine may run at a constant speed, for which it is best suited, while the speed of the propeller may be changed at will. Moreover, the control of the propeller speed may be transferred from the engine room to the pilot house, and thus valuable seconds saved when navigating difficult waters. There is probably also some gain resulting from the elimination of one human link in the chain from pilot to propeller.

The system just referred to has been tried in a small way abroad, where it is giving some degree of satisfaction; but a recent modification of it has been made which partially eliminates the defects of the other. The new system was patented recently in this country by C. Del Proporto, but it has been undergoing trial for a year past on Lake Geneva, in Switzerland, and at St. Petersburg. The principal changes made are the reduction of the size of the generator and motor and the providing of a mechanical coupling between engine and propeller shafts. Since the flexibility of the electrical system is of most service when maneuvering, which is usually done at a decreased speed, the full output of the generator and motor are not then required. This work may therefore be done by a generator and motor of reduced size. In the new system they are rated at one-half the output of the engine, which will be found ample for such purposes. For proceeding at full speed, however, the electrical system possesses no particular advantage, and may, in fact, be cut out and the propeller directly attached to the engine shaft. This is accomplished by means of a mechanical coupling, as the engine is placed so as to allow this to be done. Under these conditions the generator and motor are cut out, their armatures acting merely as flywheels, and all electrical losses are avoided. The arrangement has the further advantage of reducing the weight of the electrical apparatus. The two vessels which are now being tried have apparently given good accounts of themselves. Although these equipments are small, it is not impossible to install large engine-power on shipboard by coupling two or more engines to one shaft, and, if necessary, by using two or three propeller shafts.

Developments in this direction will be watched with interest by marine engineers, for if an oil engine may be used for ship propulsion important advantages will be gained in other ways. Oil is not only a more concentrated fuel than coal, but is more easily handled, and its adoption would do away with the large corps of firemen now found necessary as all the fuel could be handled by means of pumps. Further, the increased thermal efficiency of the engine, together with the more concentrated type of fuel, would increase considerably the useful range of the vessel.

THE STREET RAILWAY CONVENTION.

The street railway convention, held at Columbus, Ohio, October 15 to 19, was impressive in many ways. First of all, it apparently developed the fact that under the scheme of reorganization the affiliated associations would do well, and that in conforming to the ideas espoused by the parent organization a sturdy growth would be assured and success eventually crown the efforts of all concerned.

President Ely, who has labored so long and so faithfully for the success of the organization, was the recipient of a handsome tribute from the officers and executive committees of the affiliated associations. In accepting this tribute, and, in fact, in all his remarks, there was the frank expression that work had been done and there was work to do, and that no one but a strong man could hope to carry out successfully the plans which had been outlined for future effort.

The choice of the nominating committee, there is no reason to doubt, is fortunate. John I. Beggs has impressed his personality upon the minds of men and indicated the ability to carry forward successfully large undertakings. It is to be hoped that he will be as successful as his predecessor, who has set for him a very lively pace.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VII—The Practical Application of the Test Results.

1. Frequency of Sampling and Testing—The feed-water from whatever source used for the boilers ought to be sampled regularly, at shorter or longer intervals, according to the nature of the supply, and the samples should be tested in accordance with the instructions given in Article VI.

In the case of surface and river water, the amount of impurities present in the water will be high during the dry season, and also after the first heavy rains at the end of such a season. At such times, therefore, the sampling and testing of the water should occur at least once weekly, or oftener if this be possible with the laboratory staff available for the work. During the winter and spring after the dry accumulations of the summer have been washed away, surface and river waters do not show such large amounts of dissolved and suspended matter, and at these periods of the year, a monthly examination of the feed-water will suffice.

Well waters, and waters drawn from large catchment areas in mountain districts and stored in artificial lakes, do not, on the other hand, show such marked variation in the amount of impurity at the various seasons of the year; and in the case of such waters, a monthly or quarterly examination of the water is sufficient.

2. Oil—If any portion of the boiler feed be drawn from the condenser water, this ought to be specially sampled daily, and tested for oil in the manner already described. In skilled hands the test will not require more than twenty minutes to carry out, and the results obtained may save very heavy expenditure upon boiler repairs at some later date. If oil be discovered in appreciable quantities, the water should be rejected for making up the feed, or should be put through a softening plant. In this case the calcium carbonate which is formed in the softening plant will enclose and carry down the oil particles; and the softening plant will in fact act as a chemical oil-purifying plant, and save the cost of the latter.

Even when specially erected oil-separating plants are in use it will be found advisable to pass the effluent from these through the ordinary softening plant as well in order to remove the last traces of oil. The water as it enters the boilers should also be examined daily for oil, and every effort should be made to keep the feed entirely free from this most destructive impurity.

3. Alkalinity and Acidity—All waters containing carbonates of lime or magnesia in solution give an alkaline reaction with litmus paper and methyl orange, and as already stated the alkalinity test is a measure of the temporary hardness of the water. Waters showing more than five English degrees (5 parts $CaCO_3$ per 70,000 of water) of temporary hardness ought to be submitted to the action of softening chemicals before admission to the boiler, otherwise these carbonates will separate inside the boiler in the form of scale and mud. Lime-water is the chemical solution employed for removing temporary hardness. The chemistry and practice of the lime-softening process will be dealt with in the next article.

Acidity in feed-waters generally arises from the presence of organic acids, and waters of this kind should not be used if any other source of supply be available. Should it be necessary to use such waters, the acidity must be neutralized with lime or with sodium carbonate, before the water is permitted to enter the boiler. The calculation of the amount of alkali required is easily made from the results of the test with standard alkali solution. The following is an example:

Two hundred and fifty cubic centimetres of the water took 1.4 cubic centimetres of the standard alkali solution (100 cubic centimetres = 1.937 grammes Na_2CO_3.)

$$\frac{1.4 \times .01937 \times 100{,}000}{250} = 10.847 \text{ grammes } Na_2CO_3.$$

Each 100,000 parts of water will require, therefore, 10.847 parts of sodium carbonate, that is, every 1,000 cubic feet will require

$$\frac{10.847 \times 10 \times 100}{16 \times 98} = 6.9 \text{ pounds of ninety-eight per cent alkali.}$$

4. Suspended Solid Matter—Water which contains more than five parts of suspended matter per 100,000 of water should be filtered or allowed to settle in large tanks before admitting to the boilers.

Sand-filters with an upward flow are the most suitable for removing suspended impurities; since these can be quickly cleansed by washing out in the reverse direction, with clean water. When softening plant is in use, special filtration is unnecessary, for the suspended matter in the untreated water is carried down with the carbonate of lime; and the only danger in such cases is that this lime is not allowed time to settle. The water from the softening plant may therefore at times contain suspended carbonate of lime; the remedy for which is a larger softening plant. As a rule, the precipitation of lime and other insoluble matter in a water-softening plant occurs more quickly with hot feed-water; and it is advisable, wherever possible, to use heated water in the softening plant, and to take the necessary steps to avoid loss of heat during the settling process. Water in a vessel exposed to the outside air will necessarily lose much heat by radiation, and the convection currents set up by this loss will interfere with the settling of the insoluble matter.

5. Total Solids—The total solids in feed-water should not exceed twenty parts per 100,000, and, where this limit is exceeded the water must be submitted to the action of softening chemicals.

The principal salts found in feed-water are the carbonates and sulphates of lime and magnesia; while the chlorides and sulphates of these elements and of sodium occur seldom and in smaller amount. The danger of large amounts of sodium chloride being present at times of flood tide, in water drawn from tidal rivers, has already been referred to; and for boiler plants located in such positions it is necessary to have some means for quickly noting the change in the character of the water supply.

The chemist in charge in such cases either should test the water daily at full tide, for chlorides, or should provide the firemen in charge of the boilers with a salinometer of a reliable type. A test based on the use of capsules of silver nitrate containing a weighed quantity of this salt with potassium chromates as indicator may also be devised, for showing when the feed contains more than ten parts per 100,000 of sodium chloride.

As regards the treatment by chemicals for removal of the total solids, this subject will be dealt with at length in the next chapter; and it is only necessary to state here that carbonate of soda is the chemical usually employed, in conjunction with lime.

6. Temporary and Permanent Hardness—Waters testing above fifteen English degrees of temporary and permanent hardness ought not to be used without chemical treatment in steam boilers.

The heat losses and disadvantages resulting from the formation of scale are so

[1]All rights of translation and reproduction reserved. Copyright, 1906, by John B. C. Kershaw.

great that in nearly all cases in large works a positive saving results from the installation of softening apparatus.[1] Permanent hardness, *i. e.*, that due to sulphates of lime and magnesia, is the more dangerous, since these salts form a more compact and adherent scale than the corresponding carbonates. The renewal of hardness by chemicals will be dealt with in Chapter VIII, but it may be remarked here that the removal of permanent hardness is only effected by substitution, and that an equivalent amount of another salt remains in solution in the water. The lime and magnesia sulphates are converted into the insoluble carbonates, while the sulphuric acid radical remains in the water, in the form of sodium sulphate, a very soluble salt.

Where waters with a high permanent hardness test are employed for boiler-feed purposes, the total dissolved salts will therefore always remain high, even when a softening plant is in use, owing to the presence of this sodium sulphate. In such cases it is advisable to blow off the boilers oftener than would otherwise be required, since a concentrated solution of sodium sulphate is corrosive in its action upon the gun-metal and brass fittings of the boiler.

In all cases it is in fact advisable to test the water remaining in the boiler at weekly intervals, and to blow off the boiler when the total dissolved matter exceeds 250 parts per 100,000 of water.

The following are some typical analyses of feed-water from various sources, carried out by the methods described in Article VI:

TESTS OF WATER FROM VARIOUS SOURCES.

RESULTS EXPRESSED IN PARTS PER 100,000.

Description.	Total Solids.	Temporary Hardness.	Permanent Hardness.	Total Hardness.
Liverpool Corporation Water.				
1. Lake Vyrnwy	4.46	..	..	1.7
2. Rivington	10.36	..	..	3.9
3. Dudlow Lane	19.2	..	..	8.8
4. Green Lane	33.1	..	..	20.8
5. Windsor	41.7	..	..	28.5
6. Waterloo district	6.8	1.5	4.1	5.6
Various Districts.				
7. Spring water	17.6	5.6	7.2	12.8
8. Surface water	56.8	34.9	3.8	38.7
9. Surface water	47.0	..	..	..
10. From a boiler in need of washing out	687.2	..	..	..

NOTES—Lake Vyrnwy is in North Wales; Rivington is a catchment area near Bolton.

Samples Nos. 3, 4 and 5 were from the old pumping stations of the Liverpool Corporation, and are samples of well waters. Sample No. 6 is the combination of pure Vyrnwy, Rivington and well water supplied to Liverpool and District for domestic use. It is an exceptionally pure water. Sample No. 9 contained 8.8 parts of organic matter per 100,000, and gave an acid reaction with phenol-phthalein. The acidity required 10.847 parts Na_2CO_3 per 100,000 of water, to neutralize it.

Sample No. 10 contained 43.2 parts of organic matter per 100,000 of water, and showed the danger of running boilers too long without blowing off. In this case the fittings were always leaking.

[1] A scale $\frac{1}{16}$-inch in thickness is the maximum allowable in steam boilers.

Electromagnetic Control of Governors.

The use of storage batteries to assist in maintaining a constant potential on an electrical supply system by absorbing sudden variations in load, while an advantage in many ways, involves the expense of first cost and maintenance of the batteries. The same result may in part be accomplished, says H. R. Speyer, without the batteries by adding an electromagnetic control to the engine governor. An apparatus which is being used for this purpose, and which is described here, consists of an electromagnet placed on the side of the engine with its movable plunger core attached to an extended arm on the governor lever. This coil carries the whole or a proportional part of the generator current, and thus exerts on the governor lever a force which varies with the load on the generator. When properly set this action may be made to vary the speed of the engine so as to maintain a constant potential independently of the load, or even to overcompound the generator by increasing the engine speed. The coil may be provided with a shunt, enabling any desired proportion of the generator current to pass through it, thus giving control over the variations caused in the engine speed. This method is used at the Weisbaden, Germany, central station, in which instance only one-seventh of the total generator current is shunted through the controlling coil. Although this method possesses a distinct advantage in doing away with a battery, it does not enable the engine to run and the boilers to work at their most economical and constant load; therefore there may be a greater coal consumption than if the battery were adopted. On the other hand, the expense of the battery is avoided. A feature of this arrangement is that it acts before the influence of the growing load is felt on the engine, and therefore before the voltage has had time to fluctuate due to a change in engine speed. By means of this it is said that the Weisbaden station now supplies both power and lighting from the same generator. Before its adoption it was necessary to run separate machines for this purpose—*Electrical Review (London), October 5.*

Proposed Peruvian Electric Railway.

M. Emile Guarini, writing from Peru, states that there is a warm discussion going on over the question of the construction of new railways. Among the most important of those to be constructed is that running easterly, and planned to unite the western slope of the rich, fertile and virgin regions of the Amazon. The government of Peru favors a central route for strategic reasons, but this route involves two disadvantages. The new line will depend upon the Oroya road, which is being exploited by a private company, and will be less remunerative than a more northerly route. M. Guarini, who has been acting in an advisory capacity for the government, favors the northern route, since it makes possible the utilization of enormous hydroelectric powers. This road would have a length of 525 miles, and would cost $30,000,000. It could be exploited economically, and would develop a remunerative traffic if it were judiciously constructed and low rates were adopted. This road would open a quick and economical outlet for mining and agricultural products of the region crossed, particularly the fertile, but distant, sections in the east. It could be constructed entirely independently of any other projected lines, and it would be advantageous to operate it electrically, because the route offers many opportunities for utilizing electric power in mines and on farms, and many industries would sooner or later spring up along the route.

To finance the road it is proposed that the Peruvian government guarantee an interest of four per cent on the sum invested, which would amount to an annual charge of $1,200,000 as a maximum. M. Guarini suggests that an electric telpherage system offers an economical and simple solution of the problem, particularly when the local conditions are borne in mind.

THE SUPPRESSION OF INDUSTRIAL SMOKE, WITH PARTICULAR REFERENCE TO STEAM BOILERS.[1]

BY A. BEMENT.

The problem of burning bituminous coal without producing smoke can be divided into two distinct features, one referring to legislation and its enforcement, the other to the technical or engineering phase of the matter, and it is more particularly the latter feature that is considered in this paper. It is the author's wish to emphasize certain fundamental principles upon which the complicated and difficult problem of smoke production and suppression rests, rather than attempt the detailed treatment of any individual condition or set of conditions.

It is a recognized fact that bituminous coal can be burned without smoke; also that the consumption of the volatile gases results in increased economy and while great improvement has been made, there is very much still to be accomplished, and the great and foremost requirement is a technical one, demanding not only a recognition of the principles involved in smokeless combustion, but better engineering practice as affecting design of plants and furnace apparatus. In the author's opinion, the people who are to blame for present conditions, may be divided into three classes in the order of their responsibility.

First—Manufacturers of furnace apparatus.

Second — Consulting engineers and architects.

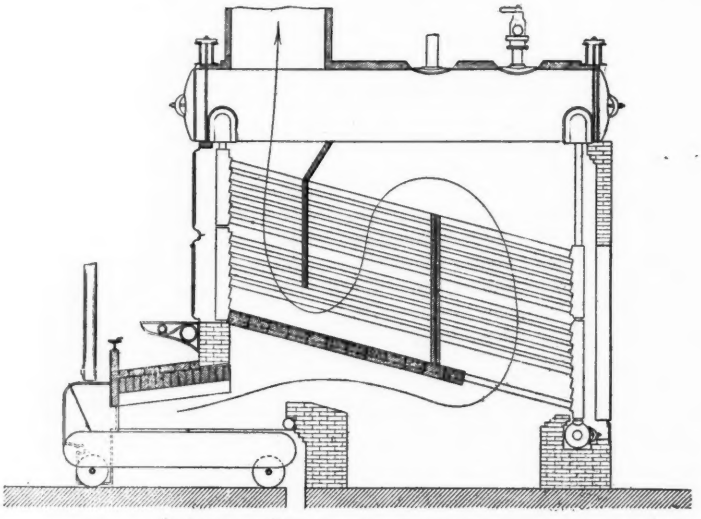
Third—Purchasers who operate the apparatus.

In considering the matter from the standpoint of manufacture, the important fact should be emphasized, that with one possible exception there are, strictly speaking, no smokeless apparatus made. This single exception will be mentioned later, but it is first desirable to outline the requirements governing smokeless combustion. They are:

First—Uniform evolution of the volatile gas, which requires with a stoker a positively uniform feed of the coal.

Second—The location of a chamber of sufficient length or capacity between the fire grate and exit to the boiler, to ensure that the volatile gases shall become thoroughly mixed with the air which enters with them.

Such chamber, which the author has called a furnace to distinguish it from the grate must of course, be made of refractory material to enable it to withstand the heat and its walls necessarily become red hot; this has caused many people to believe that the high temperature in itself was the cause of the volatile gases being burned, failing to take into consideration the fact that the most important requirement is a thorough mixing of the gases with the air in the chamber. Failure to realize this fact has resulted in disappointment with many brick arches, "Dutch ovens," etc. The chain grate, owing to its feed of coal being on a horizontal line, ensures a positively uniform rate in the feed, and consequently there is a steady evolution of the volatile gas, which will be burned if there is such furnace located between it and the boiler, and this apparatus may properly be called smoke-proof, because it is impossible for the operator to either cause, or allow the coal to be fed in other than a steady and uniform manner.



Smokeless Furnace for Steam Boilers.

Even when a very large furnace chamber is used with any form of stoker (other than a chain grate) or a hand-fired grate, a smokeless condition is dependent upon careful manipulation. For example, with a hand fire, if too much coal is added at one time, the evolution of gas will be greater than the mixing capacity of the chamber; or, with sloping grate stokers, when a large quantity of coal is poked or slides down the grate, the result is the same as when a large charge of coal is added to a hand fire. Thus the fuel feeding apparatus or method of manipulation, must not overtax the mixing capacity of the furnace chamber, if a smokeless result is to be secured.

The accompanying illustration shows the latest and best type of smoke-proof steam generator, its furnace chamber being formed by tiles covering the lower row of the tubes of the boiler. It is not a patented apparatus and may be adopted by any one who wishes to do so. In fact, many boiler plants now installed, may at small expense be altered so as to conform to all of its essential requirements. While this particular improved apparatus has already been built when demanded by purchasers, no manufacturer is willing to erect it unless required to do so. The nearest approach to a smoke-proof apparatus in the form of a complete steam generator, offered by any maker, consists of a brick arch as an essential adjunct for the direction of the gases against the tubes of the boiler, and when this manufacturer installs a chain grate under this arch, it becomes the above-mentioned exception to the rule. This does not mean, however, that a purchaser may not buy a boiler from one maker, a stoker from another and with a little engineering produce an apparatus which is strictly smokeless.

For a clearer understanding, it is essential that furnace apparatus be considered in two classes, one which is smoke-proof, the other depending upon careful manipulation for good results. This latter class may also be separated into two divisions, those which by reasonably careful working will be smokeless, and others, which it is very difficult to operate without smoke. Thus there are three grades of apparatus, the perfect, the moderately good and the bad.

The effort of health departments and smoke inspection bureaus should be to enforce the adoption of the perfect apparatus, proper manipulation of the moderately good and the abandonment of the bad. Unfortunately, however, the

[1] Paper presented before the Western Society of Engineers, October 17.

most serious offenders—the manufacturers, consulting engineers and the architects—are not affected by the smoke laws, therefore can only be reached indirectly through the purchaser who bears all of the burden. Thus the only alternative is to enforce the laws in such manner as to be most effective.

The position of the smoke inspector from the engineering standpoint is a difficult one. As a general rule he is an administrative official, appointed or elected for the purpose of enforcing laws, and his time and efforts are taken up in such work, and the character of the requirements largely determine the training of the man selected. It necessarily follows that often he is not an engineer; at all events to that extent necessary for the solution of the difficult engineering problems encountered; the conditions under which he must necessarily work, prevent to a very great extent his becoming technically proficient, because the tendency would then be for certain apparatus to be recommended in preference to others; this immediately results in trouble, caused by the influence of manufacturers who would not be favored. As it is, if a prospective purchaser applies to a smoke inspector for information as to the most desirable apparatus to be procured, he may be referred to a number of plants which are examples of good practice, in which he may find a variety of apparatus, and selecting one of these, often finds, after it is in service, that under his conditions it is not satisfactory; upon further investigation, he discovers that others labor under as much difficulty as he, and thus often feels that he is an innocent victim of circumstances.

There are many plans where conditions render it difficult to correct the apparatus except at great expense. Such cases present a real problem to the smoke inspector. On the other hand there are many owners who do not try to improve conditions, in fact, make no effort to discover whether or not they can correct their practice or the apparatus, and make promises they do not intend to fulfil. One of the most common excuses is, that their boilers are "overloaded" and for this reason they can do nothing, and unless the inspector is an engineer and familiar with this phase of the matter, he often encounters a seemingly insurmountable difficulty, when in reality these same owners, for reasons of economy, would not work their boilers at a lesser capacity. As a matter of fact, the practice which ensures a smokeless condition, also results, as a general thing, in the production of a larger capacity. The remedy with such owners is a drastic enforcement of the law.

In view of the fact that the greatest trouble is one that may be overcome by better engineering practice, and that there is no accepted or recognized independent source of information for the guidance of well-intending purchasers, it is recommended that the Engineering Experiment Station of the University of Illinois and the State Geological Survey, present information to the people of this state, which, coming from such sources, may be accepted with confidence and used to advantage.

A NEW METHOD OF EMPLOYING TWIN LEAD-COVERED WIRE FOR ELECTRIC LIGHT WIRING.[1]

BY E. L. BERRY.

At the present time there are practically only two modes of running wires for house lighting; namely, wood casing or metal tubing. Wood casing, although no doubt answering its purpose in dry situations, utterly fails in damp places. Metal tubing, if welded, brazed or seamless, thoroughly well screwed at all fittings, undoubtedly affords perfect protection from damp from without, but unfortunately its use is attended by a trouble peculiarly its own, that is to say, "condensation," so that in cases where metal tubing is employed to overcome possible defects arising from a damp situation, it is done at the expense of introducing another and equally fruitful source of trouble.

When metal tubing is employed it is undoubtedly very desirable, and in some cases even compulsory, that it should be "earthed."

Of course, in theory this is quite a simple matter, more particularly with screwed tube, yet few of the tube installations in use at the present time would stand a continuity test of the tubing from each switch and light point to the mains.

Having pointed out a very few of the defects which are possessed by tube and wood casing I suggest a substitute which in itself is by no means new, but the mode of employing it has, I think, some claim to novelty. I refer to vulcanized rubber twin lead-covered wires. I think we shall all agree that from the electrician's point of view twin lead-covered wires are ideal, in so far as there can be no damp troubles from without or condensation troubles from within, and the only reason I can assign for its not having been more popular are, firstly, the difficulty of satisfactorily jointing the wires, or of looping, if joints are to be dispensed with, in which case one wire would be wasted at each switch and light run; and secondly, the difficulty of making the lead covering electrically continuous throughout for the purpose of earthing.

Both these difficulties have, I think, been satisfactorily overcome by means of a porcelain joint box. It consists of two blocks of porcelain, the base and the cover; on three sides of the rebated edge of the base is an "earth plate," to which are screwed, opposite the points at which the wires enter, four saddles, by means of which the lead sheathing of the twin wire is securely clamped to the earth plate, thus insuring metallic continuity of the lead sheathing of the four lengths of wire which enter the box. In the centre of the base, and entirely embedded in porcelain when the cover is in position, are four contact plates fitted with the requisite number of pillar terminals for connecting the four pairs of wires. Two of these contact plates are permanently connected together in a recess at the back of the base.

That every length of wire where it enters the joint box has its lead sheathing clamped to a plate which is common to all the wires entering the box. It only remains, therefore, at each distribution board to connect the circuit wires by means of a metal strip fitted with the requisite number of saddles as fitted to the earth plate of the joint boxes, the said metal strip being connected to the lead sheathing of the mains where they enter the distribution board with a metal clip and copper wire, so as to insure the whole of the lead sheathing of all the wires of the installation being metallically continuous throughout. If the lead sheathing of the mains at the supply end is connected to a water pipe by means of clips and copper wire, we shall have, I think, a more reliable system of "earthing" than is the case with any iron or steel tubing in use at the present time.

To avoid damaging the insulation when removing the lead sheathing at the end a special form of lead cutter has been devised which, while removing the sheathing in a fraction of the time it would take to do so with a knife, effectually prevents any injury to the insulation.

Where the wiring is done on the surface the wires are fixed by means of metal saddles, either nailed or screwed, as is most suitable to walls and ceilings, the joint boxes fixed on the walls close to ceilings and in such positions as will be most convenient to the run of the wires. In

[1] Abstract of a paper read before the London section of the Electrical Contractors' Association, September 25, 1906.

cases where the wires are fixed to brickwork or plaster in damp situations, as a precaution against possible trouble arising from the local action of dissimilar metals in contact, it would be advisable either to interpose some substance such as damp-proofed tape or paper between the saddle and the lead sheathing or use lead saddles.

In the case of sunk work the joint box is fixed by means of an angle plate which is nailed to the side of the joists midway between ceiling and floor boards; the wires running with the joists are fixed by saddles nailed to the centre of the joists, and wires running across the joists are threaded through half-inch holes made in the centre of the joists with an auger bit, no further fixing being necessary. Where wires run down walls a chase is made in the brickwork wide and deep enough to take the wire; the wire is laid in and covered over with hoop steel two inches wide, which is secured by means of clout nails, driven into the joints of the brickwork close up to the edge of the steel. Where wires pass through brick or stone walls they should be drawn through bitumen tubing.

In new buildings it may be desirable to interpose water-proof tape or paper or something of a like nature between the wire and the hoop steel covering the wire chase, to obviate any local action between the lead sheathing and the steel, as in the case of metal saddles in damp places just referred to. In surface work the lead sheathing should afford ample protection against anything short of deliberate or wanton injury. Under floors the wires in all cases being run midway between ceiling and floor are out of the reach of all nails or screws. Under plaster, the covering of hoop steel will protect the lead sheathing from stray picture nails, etc., and also keep the wet plaster from contact with it.

With regard to the handling of lead-covered wire the most convenient way would be to have the 3/20 and 3/22 supplied by the makers in 220-yard lengths on small drums about twenty-four inches diameter by fourteen inches and weighing with the wire about one and one-half hundredweight. This can be readily carried about and when in use the drum should be mounted on a small stand leaving it free to revolve.

In addition to the absolute freedom from all troubles arising from the action of damp and condensation upon the insulation of the wires, and the good protection given to the wires, the system has one or two other advantages. Alterations, additions, the fixing and connecting of fittings, and the removal of faults in installations thus wired, will be as easy to a strange electrician as to the man who did the work originally. The locating of faults is a very simple matter, as the removal of the joint box cover gives access to both ends of every unbroken length of wire throughout the installation.

Less skilled labor is required, the only part of the work requiring electrical knowledge being the connecting of the joint boxes, fittings, switches and distributing boards. The cost of a mile of 3/20 twin lead-covered wire, as compared with a mile of five-eighths-inch slip socket tube with the average number of bends, tees, etc., enclosing two miles of 3/20 ordinary vulcanized wire of the same class, shows a saving of anything from twelve to twenty per cent, the difference being due to the varying proportion of tube fittings to tube on different installations.

To put this method of wiring from its economic point of view in the worst light, and assuming that there is no saving in either labor or material, it will still effect a very considerable reduction in the work entailed in office, stores, and in the value of the contractor's stock.

Electrical Equipment for the Indiana Steel Company, Gary, Indiana.

At Gary, Indiana, there is being constructed by the United States Steel Corporation a plant for the manufacture of steel. The new plant when completed will make use of substantially 5,000,000 tons of ore per year and will produce annually nearly 2,500,000 tons of steel. Along with the completion of the various buildings of the new plant an entirely new city is going up, with parks, theatres, streets and water and sewage systems all planned.

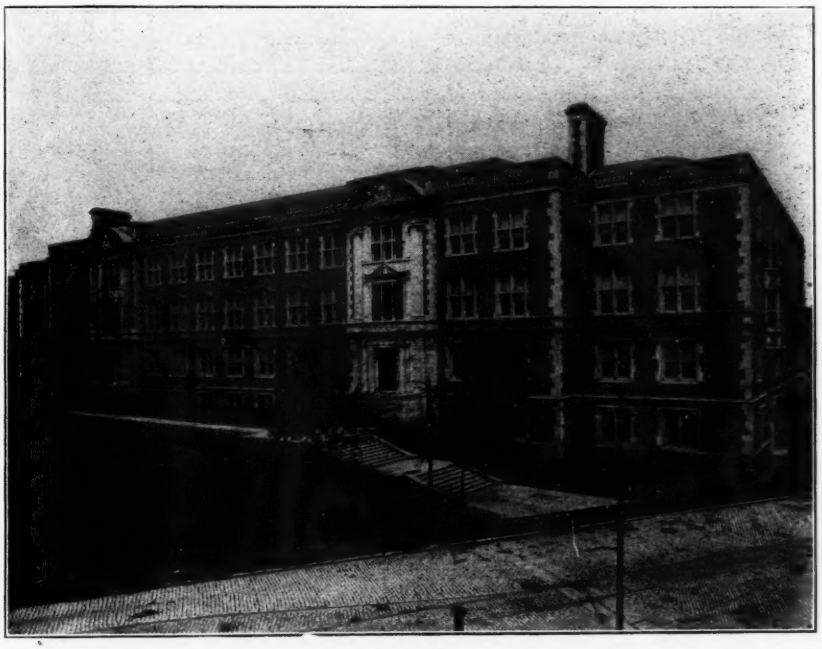
Quite in keeping with the immensity of this project are the plans for the detailed equipment. Practically all the machinery in the steel plant will be driven electrically, the gases from the blast-furnaces being, as far as possible, used for the generation of the necessary power. One of the first buildings to be equipped will be the rail mill, and the induction motors which will be used are not only of interest because of their size, but because of the special method of control. Moreover, this will be the first steel mill in this country to operate its rolls by induction motors. Six General Electric three-phase induction motors, ranging in capacity from 2,000 to 6,000 horse-power, will be used to drive the main rolls. These motors are reversible and are specially controlled. Due to the heavy overloads to which these machines are necessarily subjected, each motor is provided with a heavy flywheel, which, with the system of control, stores up energy when running normally and returns it to the rolls when subjected to a heavy overload. In addition to the heavy flywheels, each induction motor has an overload capacity of fifty per cent for one hour. Thus, three of the motors having a normal rating of 6,000 horse-power can each deliver 9,000 horse-power for one hour when called upon to do so. Mechanically, these motors are of unusually sturdy construction, being built heavy and rigid to withstand the shocks to which they will be necessarily subjected. At the same time the construction is as simple as is consistent with reliability. The heavy bearings and general massive appearance of these motors is quite in keeping with the powerful rolls which they drive.

The method of controlling these motors was specially designed by the General Electric Company for this service and is very interesting. A master controller is used from which the main line oil switch can be opened or closed, the reversing switch thrown in either position, or the resistance cut in and out of the rotor circuit in successive steps by means of electrically operated switches or contactors. The main line switch is a triple-pole, single-throw electrically operated oil switch, and the current passing through this is led through the reversing switch, a double-pole, double-throw, electrically operated oil switch. Special precautions have been taken to insure the automatic protection of the control system. It is impossible to operate the reversing switch unless the main line switch has been previously opened, and if the main line switch has been opened by the overload trip, it can not be closed without first bringing the controller to the off position.

As has been stated, a special arrangement is used to assist the flywheel in restoring energy to the motor. So-called "slip relays" are provided in which the actuating coil carries the current of the motor. Whenever the motors are subjected to overloads, the slip relays operate, cutting a small portion of the resistance into each phase of the rotor circuit, causing the motor to slow down gradually and the flywheel to give up a portion of its energy. When the load is taken off the motor, the reverse operation takes place and the motor speeds up, returning the energy to the flywheel.

The Engineering Building of the University of Pennsylvania.

A LARGE assemblage of distinguished educators and engineers took part in the exercises dedicating the new engineering building of the University of Pennsylvania. A number of foreign governments, various branches of the Federal government and more than a hundred scientific societies and educational institutions sent delegates to represent them at the opening ceremonies, which took place on October 19. The principal addresses were delivered by Frederick W. Taylor, president of the American Society of Mechanical Engineers, and by Dr. Alexander C. Humphreys, president of Stevens Institute of Technology. They were introduced, respectively, by Professor Henry W. Spangler, head of the mechanical engineering department of the university, and Professor Edgar Marburg, head of the civil engineering department. Provost Harrison conferred a number of honorary degrees on distinguished engineers. In the evening the guests of the university were entertained at a dinner given by the alumni of both departments.



NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

The new building is the largest of the university group of seventy buildings, having a frontage of 300 feet and depth of 210 feet at one end, and 160 feet at the other. The approximate cost including equipment was nearly a million dollars. It is of fireproof construction, and the equipment is of the most modern and approved type. The exterior is of dark brick, with limestone trimmings, and the general architectural treatment is in the English Georgian style. There are three stories, with basement covering about a third of the entire building, the total floor area being 128,000 square feet. The heating is by direct steam, each room being heated by steam coils supplied by low-pressure steam from the central station, after having been used in the engines. The ventilation is by electrically driven fans, located in the attic and the basement. The system is divided into sections, each with a separate fan and tempering coils, so that only that portion of the building in use has fresh air pumped into it. The fans may be controlled from any room in the building. The building is lighted by electricity.

The basement contains locker rooms, lavatories, machinery for heating and ventilating, storage battery rooms, laboratories for geodetic and hydraulic work, and for the testing of the materials of construction.

On the first floor, adjacent to the main entrance, are the offices of the heads of departments, the east end of the building being devoted entirely to the civil engineering department, and the west end to the mechanical engineering department. There are two principal entrances leading to the main hallway, which extend east and west the entire length of the building, with staircases at both extremities. Two large light wells terminate in skylights over the ground floor.

The Lesley cement laboratory for the testing of cements, mortars and concrete occupies the southeast corner. This room contains testing machines of various types for tensile, compressive and bending tests, a briquette-making machine, immersion tanks, damp-closets, etc., and a number of individual work tables, each completely equipped with an outfit of minor apparatus. Special provision is made for investigating the properties of plain and reenforced concrete.

The eastern side of this floor is otherwise occupied by the main physical testing and hydraulic laboratories, both extending partly into the basement, as previously stated. The former contains universal testing machines of various types, ranging in capacity from 30,000 to 60,000 pounds; machines for torsion, bending and impact tests, besides a complete outfit of extensometers, deflectometers, micrometers, etc.

The hydraulic laboratory contains a pressure tank five and one-half feet in diameter and thirty-seven feet high, having a total capacity of 5,800 gallons, for experiments on the discharge through orifices and tubes, and two calibrated weir-tanks, five by five and one-half feet in cross-section and thirty-four feet long. These tanks are provided with partially removable ends to permit also of observations of flow over submerged weirs and dams. Two weighing tanks, having each a capacity of 1,800 gallons, have been mounted on scales at the discharge ends of the weir tanks, and will themselves empty by quick-discharge valves into the main supply tank directly underneath. This tank has a capacity of 23,000 gallons, and is connected with the city water mains, and, by overflow and drain pipes, with the sewer. It is below the basement floor level, so that it receives the discharge from any piece of apparatus either on the basement or first floor level. An eight-inch tubular well, 100 feet deep, passes through the floor of this tank and will be utilized in connection with experiments on the efficiency of various forms of deep-well pumps and air-lifts. The pumping plant consists of three units independently driven by variable-speed motors, so that

they may be operated either separately or combined and at various speeds, thus ensuring a wide range in the rate of supply.

Various pipe circuits are provided and connected with a twelve-inch standpipe, extending from the basement to a height of about sixty-five feet, or somewhat above the main roof. From numerous connections along these pipe lines water is supplied to various forms of minor apparatus.

On the west end, opening out of the main hall, is an instrument-testing room for the calibration of indicators, thermometers, calorimetric work with fuels, etc., and beyond that an electrical-standard room for the comparison and correction of electrical testing apparatus of every variety. The remaining mechanical and electrical laboratories are situated on a floor four feet below the entrance hall.

The central space under the skylights, about 200 by 50 feet, is utilized entirely for workshops. In the western end is a foundry equipped with a small cupola, brass furnaces and light crane for handling flanks and ladles. A moderate-sized sand floor in the centre, and a small core-oven and benches around the outside, complete the equipment.

The wood-working and pattern shop extends to the middle of the building, and is divided into two parts, the one intended for beginners and the other for students engaged on pattern work.

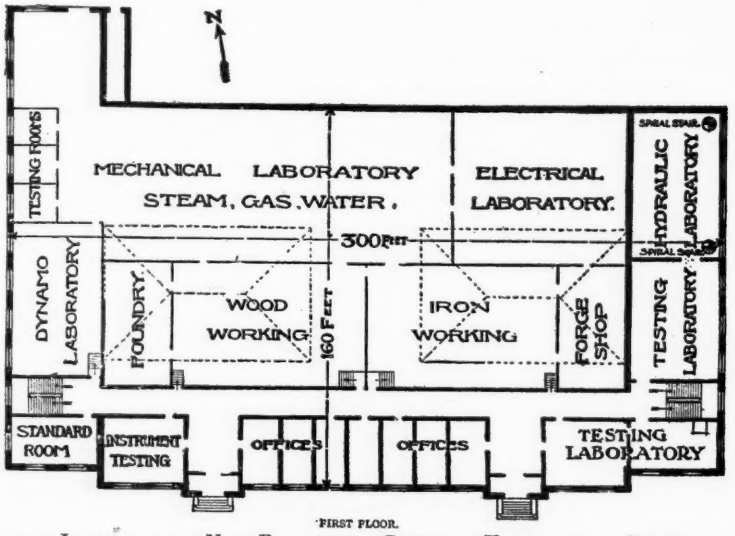
The tool room supplying the wood and iron shops has been placed directly at the centre of the building. To the east of this is an iron-working shop divided into two departments, one for beginners, the other for more advanced students.

The various forms of lathes, planers, drill presses, etc., required in a modern shop, have been installed, besides a number of electrically driven tools.

The eastern end of the shop space is devoted to the forge shop, with accommodations for fifteen men working simultaneously. Collectively, the shops accommodate about ninety men working at the same time.

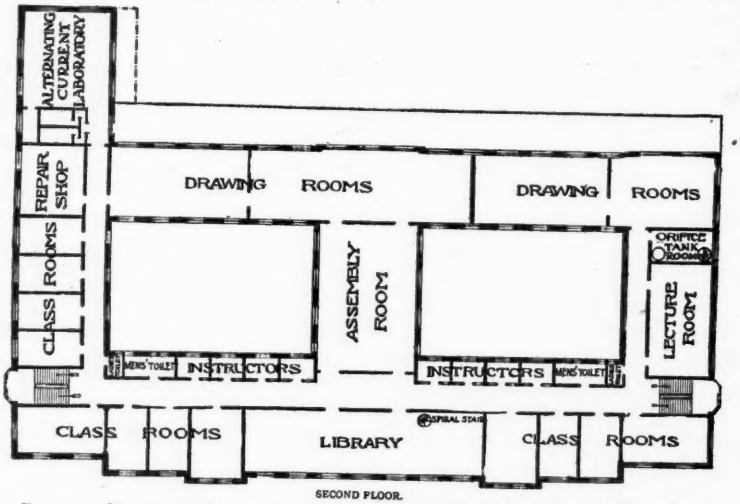
To the west and north of the shops are the mechanical laboratory and a part of the electrical laboratories. At the western entrance is a dynamo and motor room in which direct-current work will be carried on. Provision for high-voltage and railway work has been made in the adjacent laboratory.

In the mechanical laboratory steam and gas engines have been installed, each installation being complete with its apparatus for doing the special kind of testing for which it is to be used. Certain engines are used for valve settings, others for determining mechanical efficiency and others for determining the entire heat efficiency of the installation. A condensing apparatus and a small cooling tower for the steam engines and moderate-sized suction producer in connection with the gas engines makes a complete working installation. A high-pressure water service with accumulators and belted and steam-driven air-compressors make it possible to carry on any experiments with hydraulic and compressed-air transmission. A boiler of 100 horse-power to supply saturated or superheated steam for experimental purposes has been installed near a small erecting floor, on which any kind of machine may be mounted and quickly connected up. Special testing rooms have been provided for refrigerating work, for experiments on heat transmission through pipes and radiators, and for experimental work on fans. There are also apparatus for measuring power transmitted in various ways and for testing the materials used by the mechanical engineer. A large water-supply tank located above the third floor, and cisterns beneath the first floor will receive the discharge from the various machines. A number of water-wheels, steel flumes for handling the water, and weirs and meters for measuring it, afford facilities for laboratory work in this line.



PLAN OF LABORATORIES—NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

Adjacent to the mechanical laboratory is the electrical laboratory, in which all measurements and testing to be made



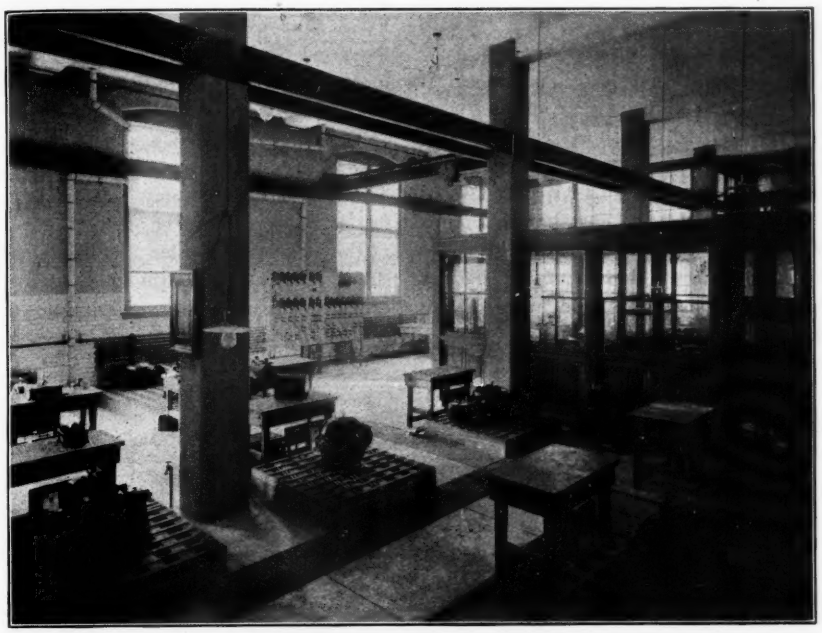
PLAN OF DRAWING ROOMS AND CLASS ROOMS—NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

away from the machines will be carried on.

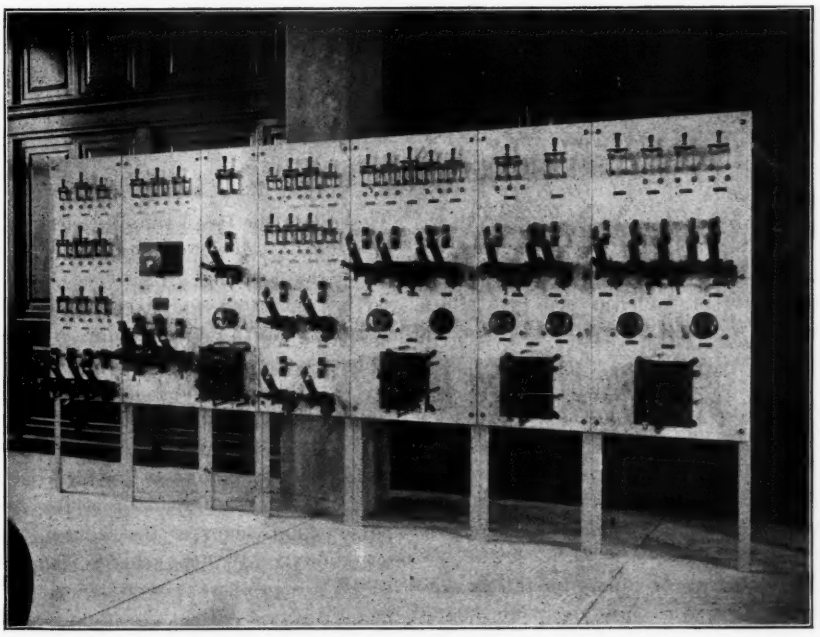
There are in all five rooms in the new engineering building which are used for practical work in electricity. Each of them is amply lighted and all have concrete floors. In every case provisions are

made so that any one experiment may be carried on entirely independent of every other one.

The instrumental laboratory, where the men meet with their first practical work is for experiments in the measurement of electromotive force, current, resistance, temperature coefficient, thermoelectric effect, inductance, capacity and permeability. The calibration of voltmeters, ammeters and wattmeters (indicating and integrating) and the determination of galvanometer constants is also done here by the student. This laboratory has a floor space of over 4,500 square feet (seventy-two feet by sixty-three feet), part of which is enclosed for an apparatus room. It is on the ground floor and nearly all under skylight. There are also three instructors' offices and a room for the storage batteries for the use of the laboratory. These offices and the instrument room are located in the middle of the laboratory, forming a division of the large room into two parts of approximately equal size. One of these parts is used for senior students and one for juniors. The divisions are each completely equipped for two laboratory sections, which may work simultaneously or at different times.



DIRECT-CURRENT DYNAMO LABORATORY.



ALTERNATING-CURRENT DYNAMO LABORATORY—DISTRIBUTING SWITCHBOARD.

There is a table and a galvanometer pedestal for each student, there being accommodations for twenty-four men (twelve in each section) on the junior side and eighteen men (nine in each section) on the senior side. These tables consist of two concrete pillars each about two feet high, which carry a slab of slate twenty-six inches by forty-four inches and one and one-half inches thick. The pedestals, which are located immediately in front of the tables, are built of one large concrete pillar, each being capped with a slate slab fifteen inches by forty-four inches by one and one-half inches thick. They are the same height as the tables.

Each of the two groups on both junior and senior side is provided with its own switchboard and its own storage-battery installation, which adds to the individual completeness of each group.

Each of these four switchboards is built of white Italian marble, as are all the switchboards in the electrical laboratories. They are supplied by the Walker Electric Company.

Every table in the room is provided with a slate terminal board upon which are mounted four binding posts, each of which is connected to its plug socket located on the switchboard feeding that part of the laboratory. By this means, any source of supply on the board can be connected to any table in the section the board feeds.

To secure the best insulation, all wiring used in this laboratory is rubber covered. It is run below the floor level in concrete drains which are covered with rolled-steel floor plates.

Each of these four switchboards is fed by a battery of eighty storage cells. These have a normal eight-hour discharge rate of three amperes on a one-hour rate of twelve amperes. They are provided chiefly for purposes requiring high potential and small current.

Each battery of eighty cells is divided into four groups of twenty cells each. The two end groups are arranged as end cells. Two twenty-one-point, button contact dial switches are connected in multiple with each group of end cells, and each of these switches is accompanied by a five-point switch similarly constructed which connects with the points where the large groups of twenty are joined. This makes a total of four twenty-one-point and four five-point dial switches per board, *i. e.*, four sources of storage-battery electromotive force, which can be independently

varied, and whose ranges are from two to 160 volts. By means of a single switch the entire eighty cells may be thrown into an arrangement of forty cells in series and two in multiple for charging.

An additional storage battery of six cells for each junior and twelve cells for each senior laboratory is installed. These cells have each a normal discharge rate of fifteen amperes for eight hours or sixty amperes for one hour. Many different combinations of series and multiple arrangement may be got with them, and on the senior board several hundred amperes are available at any part of the laboratory.

All switchboards in this laboratory are also supplied with 110 volts from the dynamos which supply the current for the building, and each circuit on all the boards is protected by a circuit-breaker.

The boards on the senior side have also alternating current which comes from a special generator used for this purpose alone.

By the arrangement of plugs that is employed, the establishment of any desired circuit can be accomplished as quickly as on the modern telephone.

As sources of energy for some of the more elementary work, twenty-five primary batteries are provided.

The floor space in the direct-current dynamo laboratory is over 2,000 square feet (thirty-three feet by sixty-two feet), and it has an instrument room and an instructor's office.

Like the instrumental laboratory, it is on the ground floor. The wiring also is installed in a manner similar to that in the above room. The wire used is fire and waterproof and not rubber-covered.

The dynamos and the motors driving them, as well as the motors for test, are all placed upon raised concrete foundations of sizes varying from four feet square to eight feet square. These are approximately six inches in height, and on top of them are placed wooden runners of three inches by four inches yellow pine at a distance of about six inches apart. On top of these wooden pieces are iron straps laid at right angles to them. The irons are screwed to the wood which is bolted to the concrete. The machines rest immediately upon the iron strips and may be clamped in any desired position.

All vibration produced by the machines is taken up in the wood. The machines are set up in position for the respective tests upon which they are to be used. There are twelve tests, and each is provided with a testing table. These are made of heavy oak and are attached to the foundations by means of bolts imbedded in the concrete. Switches for short-circuiting the ammeters, and line switches, as well as field rheostats, are all permanently attached to the tables. All test machines are, however, connected up each time by the student who is running the test.

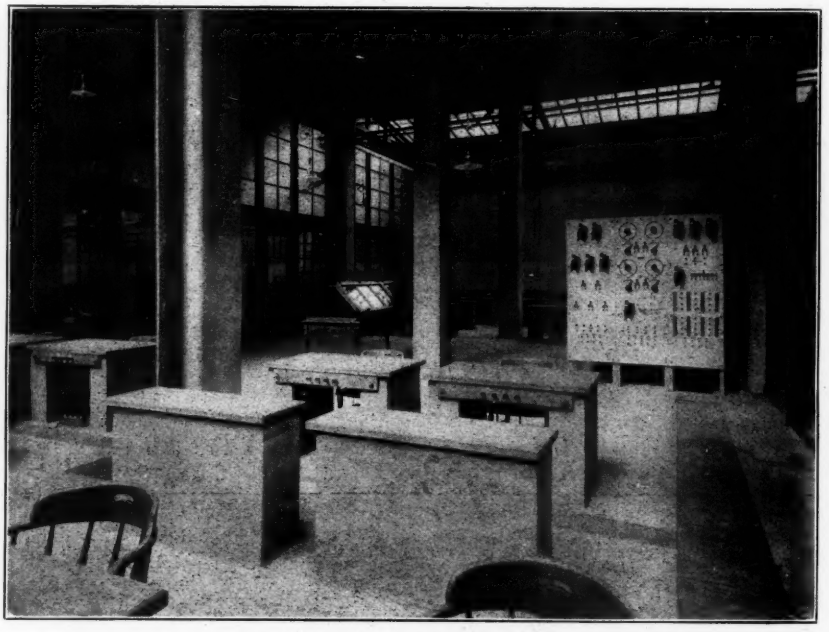
A slate terminal board is placed at each test, and there are four binding posts mounted on each which are wired to plug sockets located on the bottom of the switchboard. One panel of this board is devoted to the storage-battery installation that is provided for this room. These batteries are located in the regular storage-battery room in the basement, and are arranged so that current can be got at six, twenty, 110 and 150 volts. At the lowest voltage they will supply forty-five amperes for eight hours or 180 amperes for one hour. While at twenty volts they will give fifteen amperes for eight hours or sixty amperes for one hour. At each of the higher voltages the current available is four and one-half amperes for eight hours or eighteen amperes for one hour. This is used for such purposes as measuring armature and field resistance, also for any other purpose where a steady source of current is required.

The main power supply for this laboratory is from the building power-house. Five hundred amperes are available at 110 volts. The main circuit is protected by a circuit-breaker of that size, while each motor and all test circuits are equipped with circuit-breakers of proper size.

The machines found here, together with the tests upon which they are used, are a General Electric five-horse-power shunt motor, a Westinghouse five-horse-power shunt motor, a General Electric five-horse-power series motor, a Crocker-Wheeler five-horse-power series motor, a Dallett five-horse-power differential compound motor, and a Westinghouse five-horse-power differential compound motor.

These motors have a special form of pulley to allow a circulation of water. There is a water supply located at each test and a drain to carry off the water.

Two exactly similar five-horse-power shunt motors of Westinghouse make are provided for use in the investigation and location of losses by Hopkinson's method.



SENIOR INSTRUMENTAL TESTING LABORATORY.

These have the losses supplied electrically and can be belted together or direct-connected by coupling.

The generator equipment consists of a two-kilowatt Edison shunt generator belted to a three-horse-power Wagner motor, a three and one-half-kilowatt Holtzer-Cabot compound generator belted to a five-horse-power Crocker-Wheeler shunt motor, a three-kilowatt Crocker-Wheeler compound generator belted to a five-horse-power shunt motor of the same make, a one-kilowatt Weston shunt generator belted to a two-horse-power Lundell shunt motor and a five-light Thomson-Houston arc dynamo belted to a five-horse-power Crocker-Wheeler shunt motor.

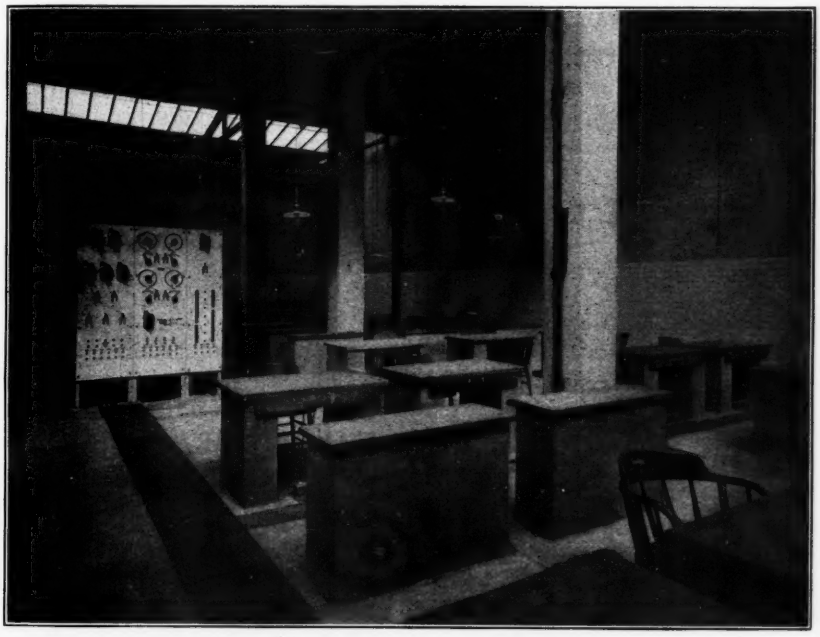
The alternating-current laboratory is located on the second floor. Its total floor space is over 2,100 square feet (thirty-eight feet by fifty-six feet), and with-

in it are an instrument room, an instructor's office and the photometer rooms.

All test machines are mounted on raised foundations in the same manner as that found in the dynamo laboratory, previously described.

In the same manner, also, each test is provided with its own table, to which are attached all switches for the work. A slate terminal board is provided which carries four, six or eight binding posts as the case may require. For example, in case of a six-phase rotary converter there are eight binding posts, two for the direct current and six for the alternating side.

All wire used in this room is fire and weatherproof and is run open, attached by



JUNIOR INSTRUMENTAL LABORATORY.

cleats to wooden runners imbedded into the plaster of the ceiling for this purpose.

Each test is provided with its own generator and is independent and complete in itself. These generators are motor-driven, all being direct-connected sets, and both motors and generators, as well as the circuits from the latter to their tests, are controlled from the switchboard.

This switchboard is the largest board in the building for laboratory use and consists of seven panels. It is somewhat over fourteen feet in length, and all circuits are protected by circuit-breakers.

The direct-current motors in this laboratory, which are used to drive the generators, also the direct-current field excitation, are supplied from the power-house in the building, at 110 volts. Five hundred amperes are available.

The following generating apparatus is placed in the alternating-current laboratory:

A Wagner four-kilowatt, sixty-cycle, 104-volt generator, belt-driven by a seven-and-one-half-horse-power General Electric motor.

A Westinghouse two-kilowatt, sixty-cycle, 104-volt generator, belt-driven by a three-horse-power Robbins & Myers motor.

A 125-cycle, fifty-two-volt Holtzer-Cabot motor which starts as a repulsion motor. This is supplied with power from a small Westinghouse generator which is driven by a two-horse-power General Electric shunt motor.

A group of four four-kilowatt generators, direct-connected to a fifteen-horse-power differential compound motor supplied by the Fort Wayne Electric Works. These generators supply power at different frequencies and voltages to a number of transformers, synchronous and induction motors, arc lamps and other apparatus.

Among the motors in the laboratories are:

A General Electric three-horse-power, sixty-cycle, single-phase synchronous motor, provided with a one-half-horse-power direct-current Westinghouse motor for starting.

A five-horse-power, two-phase, 110-volt, sixty-cycle, variable speed induction motor of General Electric make, which draws power from a five-kilowatt generator direct-connected to a seven-and-one-half-horse-power motor supplied by the Westinghouse Electric and Manufacturing Company.

A General Electric ten-horse-power, three-phase, 110-volt induction motor supplied with power from a Fort Wayne direct-connected set consisting of a seven-and-one-half-kilowatt generator and a ten-horse-power motor.

A multiphase rotary converter, 110 volts on the direct-current side, supplied by the General Electric Company. This machine draws power from the direct-connected Fort Wayne set when converting from alternating to direct current.

All the laboratories are amply equipped with the best makes of measuring instruments, so that no student's work is hampered in this regard. There are also generous supplies of other accessories, such as rheostats, resistances, condensers, lamps and other devices.

On the second floor of the building a reference library and reading room occupy the central space on the front of the building. The library and stack at one end will hold about 20,000 volumes. The library is flanked on either side by a series of recitation and lecture rooms, which are continued along both ends of this floor. Between the light-wells at the centre of the building is a students' assembly room with about 2,500 feet of floor space. There are also a number of rooms for instructors along the south side of the light-wells.

The rear portion of this floor for nearly the entire length of the building is assigned to drawing rooms. A separate room will be allotted to each class and an individual desk to each student, so that he may have free access to the same at all hours.

On the third floor is a large room for the use of the engineering societies, a general supply store and the library stack extends through the middle of the front of the building; the space along the front being otherwise assigned to class rooms and to instructors' rooms along the south of the light-wells.

In the east and west wings, spacious rooms have been set aside for engineering museums. The rear of this floor is also devoted to drawing rooms which, like the drawing rooms on the second floor, will have the full advantage of north light through windows of ample dimensions.

The engineering department of the university was established in 1874, but the constant increase of numbers in the classes of the departments has necessitated their moving into more spacious quarters three times since their founding. The departments this year have a total enrollment of nearly 600 students, and a teaching force of forty.

CAR BRAKES.[1]

BY HENRY MOZLEY (GENERAL MANAGER, BURNLEY CORPORATION TRAMWAYS.)

In view of the large number of accidents on tramways recently owing to failure of brakes, and the anxiety of the executive committee to have the question considered in all its bearings, I had no hesitation in complying with the request to give the Association the benefit of our experience with brakes at Burnley, and my committee instructed me to furnish you with any information you required. Municipal authorities, having only one interest to serve, can approach the subject without suspicion of bias, and makers of brakes may be assured that it is the public interest and safety alone which the Association has in view; moreover, this very disinterestedness enables local authorities to freely communicate to each other their common experiences and information without let or hindrance.

The Burnley Corporation Tramways consist of a trunk line seven miles twelve chains in length, and three branch lines a little more than one mile each. The trunk line was worked with steam power for twenty years, the locomotives weighing ten tons ten hundredweight in working order; bogie cars weighing four tons, and having a seating capacity of sixty-four passengers, so that loads of twenty tons were frequent. The brakes were actuated by steam power upon all the twelve wheels simultaneously, and on no occasion during the period did an accident occur caused by a failure of brakes.

Fig. 1 shows the nature of the route. The Padiham section is three miles nineteen chains in length, having very little level in it, the characteristic of the route being a steady rise to Park-lane from both directions—the exact rise Padiham to Park-lane being 257 feet, and the distance two miles three chains; and Calder Vale to Park-lane 155 feet, the distance seventy-five chains; thus showing that we had long been accustomed to controlling heavy weights on severe gradients, and made us very much alive to the importance of brakes when the time came for the introduction of electric traction A section of this portion of the line is given in Fig. 2.

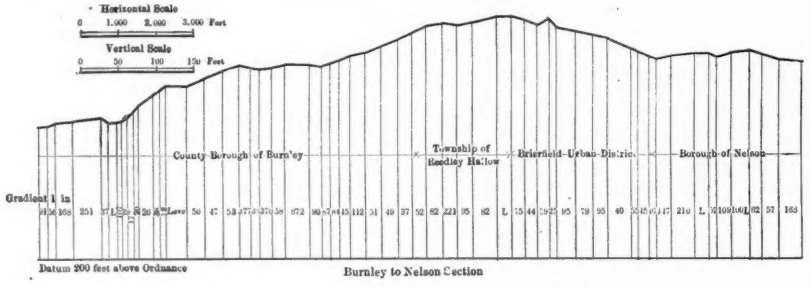


FIG. 1.—GRADIENT LINE, BURNLEY CORPORATION TRAMWAYS.

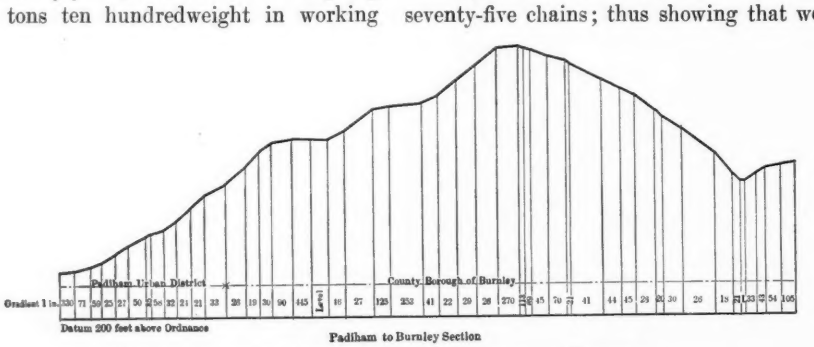


FIG. 2.—GRADIENT LINE, BURNLEY CORPORATION TRAMWAYS.

The trunk line has been worked electrically from March, 1902. The cars are double-decked bogies, equipped with Brill maximum traction trucks and British Thomson-Houston motors, their weight being twelve tons ten hundredweight and seating capacity seventy, the weight, fully loaded, seventeen tons ten hundredweight, with occasional heavier loads. There have been no accidents connected with the brakes, which are the simple hand-brake improved by ourselves, and the rheostatic brake. Track brakes are not required or used on this route.

After the trunk line had been in operation twelve months and the result being satisfactory, my committee began the construction of the three branch lines. One of these, the Manchester-road branch, is of an exceptionally dangerous character, having a continuous gradient averaging 1 in 18 for the full distance and 1 in 9.8, 11 and 12 in parts near the junction with the trunk line, the actual rise being 340 feet in one mile, thirteen chains.

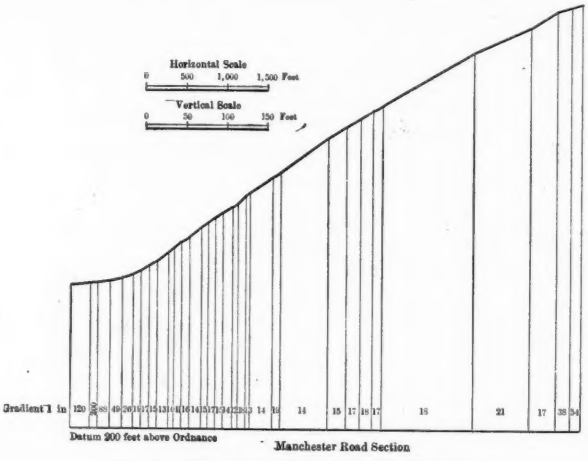


FIG. 3.—GRADIENT, MANCHESTER SECTION.

Fig. 3 will illustrate the nature of the gradient very clearly.

The car for this and the Towneley route (worked as one line, horse-shoe shaped, and touching the trunk line in Burnley center) is of special design, having a large inside seating capacity forty-four, the Towneley branch having a low culvert under the Leeds and Liverpool Canal. This necessitated four motors, thus bringing up the weight of the car to fourteen tons, twelve hundredweight, fifty-four pounds, empty, and seventeen tons, ten hundredweight, 110 pounds, fully loaded.

You will readily understand that to control this weight on such heavy gradients the best brakes obtainable were necessary, and my committee appointed a special subcommittee to deal with the question, and it is from this point the subject will

[1] Paper read before the Leeds meeting of the Municipal Tramways Association on September 19. (Slightly abstracted.

be the most interesting and instructive. We had come to the conclusion that only mechanical track brakes were suitable, and made full inquiries into all types of track brakes known to tramway men, including the Hewitt & Rhodes' air brake erected on cars at Oldham (this brake was used for emergencies only and appeared to be too unreliable in the matter of maintenance), and found not one would answer our requirements. We were, therefore, driven to the necessity of designing one.

This brake was erected on a locomotive we were building at the time, and its performances were so satisfactory that it was resolved to adopt it for the Manchester road cars, and here I may say that during the trials it was found that it would be unsafe to use wood for the slippers, and that soft grey cast iron was the only suitable and safe material. Before this point was reached we had obtained some reliable information and experience of magnetic brakes, which, by this time, had begun to interest tramway men. I propose to go into a little more detail to make clear to you the causes which proved to us the unsuitableness of the magnetic and the adoption of the mechanical track brakes with cast-iron slippers in place of wood —the general practice where mechanical track brakes are used. We had been accustomed for twenty years to the use of the mechanical brakes, and it was a considerable shock to go back to hand brakes when electricity was put into operation, and we naturally kept a lookout for a remedy for this backward step, and the magnetic brake appeared to fulfil the requirements. We, therefore, obtained permission to try two rival magnetic brakes for the purpose of ascertaining their suitability for service brakes, and at the same time ascertain whether the brake could be used on the Manchester road cars.

By this time we had gained considerable experience of the rheostatic brake, and found that it was highly destructive to the motors and could only be used for emergencies. The magnetic brake being actuated by the same means, we took the precaution of requiring the makers to satisfy us by actual measurements as to the voltage and amperes generated by the motors. Both makers entered into an agreement to do this, and the brakes were erected on Nos. 6 and 7 cars, the cars being precisely alike.

The Newell brake was fixed to No. 6 car, but we could not use it as a service brake owing to the high current generated causing the resistances to overheat, its tendency to skid the wheels and other causes, and it was removed and returned to the makers.

The British Thomson-Houston Company's brake was kept in service five months, and during that time three armatures were burnt out, and the brake had to be abandoned. After the second armature failed the makers made important alterations in the magnets, which lessened the pressure on the motors, but notwithstanding this improvement one more armature burnt out, and we were then convinced the magnetic brake was unsuitable for service purposes.

The makers took measurements as required by the agreement, and Table I gives the statement supplied by the British Thomson-Houston Company's engineer.

The Westinghouse company's representative failed to supply the readings which were taken by them, but I append, in Table II, readings taken by ourselves at a later date, and after the British Thomson-Houston Company had altered the magnets of its brake.

The data are placed side by side for convenience.

TABLE I—TESTS OF BRITISH THOMSON-HOUSTON MAGNETIC BRAKES—JULY 22, 1903.

From Pole No.	To Pole No.	Distance, Feet.	Time, Seconds.	Speed.	Reading in Amperes.	Volts.
101	84	1,856	102	12.4	35 to 17	400 to 200*a*
73	65	857	43	13.6	35 to 15	400 to 200*b*
49	46	328	14	16.0	47 to 34	550 to 300*c*
..	..	...	..	....	90 to 25	800 to 250*d*
37	34	351	15	16.0	48 to 28	590 to 350*e*
..	..	...	21	11.4	90 to 25	800 to 300*d*
49	46	328	20	11.2	29 to 24	250 to 210*f*
..	..	...	20	11.2	32 to 29	300 to 200*g*
					Momen- Contin- tarily. uously.	Momen- Contin- tarily. uously.
37	34	351	..	....	50 25	400 to 220*h*
..	..	...	21	11.4	25	250*i*

a 1st notch—Grades 1 in 26, 1 in 28, 1 in 22, 1 in 40, 1 in 253. No flashing or sparking of motors.
b 1st notch—Grade 1 in 26. No flashing or sparking of motors.
c 1st notch—Grade 1 in 18.
d 1st notch—High ampere and volt readings due to high initial speed of car, which had not come to an even speed when readings taken. No flashing or sparking of motors.
e 1st notch—Grade 1 in 21.
f 2d notch—Grade in in 18.
g 2d notch—Speed of car fairly constant when readings taken. No flashing or sparking of motors.
h 2d notch—Grade 1 in 21.
i 2d notch—Car had come to even speed when readings taken. No flashing or sparking of motors.

The tests were carried out on certain down grades on the tramway route, as indicated by pole numbers in Table II.

During the tests these grades were approached at a fairly high rate of speed, and shortly before reaching the first pole marking the prescribed course the track brakes were applied. The time required to cover the distance was noted, and concurrent readings were taken of amperes and volts at intervals of four or five seconds. From these observations was determined the average speed of car when descending the grade under the action of the brake, also the average total amperes generated by motors and the voltage across

TABLE II—TESTS MADE DECEMBER 22, 1903.

Pole No.	Distance, Feet.	Grade.	Brake.	Time, M. S.	Speed.	Average Amperes.	Average Volts.
101–84	1,856	1 in 26	B.T.-H.	1 47.5	11.75	13.4	135[1]
..	..	1 in 28	..	..	..	..	..
..	..	1 in 22	..	..	..	..	..
..	..	1 in 40	W.	1 47.0	11.80	19.2	198
..	..	1 in 253	..	..	..	..	..
73–65	857	1 in 26	B.T.-H.	0 46.4	12.6	16.0	204[2]
..	..	..	W.	0 4.90	11.9	16.0	146
49–46	328	1 in 18	B.T.-H.	0 17.0	13.1	28.0	326[3]
..	..	..	B.T.-H.	0 12.8	17.4	47.0	584
..	..	..	W.	0 11.8	18.9	51.5	710
37–34	351	1 in 21	B.T.-H.	0 15.5	15.45	35.0	453[4]
..	..	..	B.T.-H.	0 16.6	14.4	30.0	386
..	..	..	W.	0 16.0	14.95	40.0	532

[1] Car brought to a stop with British Thomson-Houston brake, eighty-two amperes maximum current.
[2] Dead stop made with eighty-five amperes maximum British Thomson-Houston brake and 100 amperes + Westinghouse.
[3] Westinghouse resistance smoking, stop made with 100 amperes + British Thomson-Houston brake and 100 amperes + Westinghouse brake. Westinghouse wheels skid; British Thomson-Houston very slightly.
[4] Dead stop, no skid; 100 amperes British Thomson-Houston and Westinghouse.

the motor armature. The results are shown in Table II. Rails were very greasy.

In the above Table II the average values of amperes and volts are computed from the readings taken when running between poles indicated in first column. The momentary high values observed when bringing the car to a stop have not been considered in computing the average.

Several emergency stops were made on slight down grade with the following results:

Whose Brake.	Distance to Stop.	Time.	Volts.	Remarks.
B.T.-H.	67	5	640	With Westinghouse brake motors flash and wheels skidded slightly. No flashing or skidding with British Thomson-Houston brake.
B.T.-H.	54	4	320	
W.	130	7	1,160	

The second emergency stop with the British Thomson-Houston brake was an entirely satisfactory stop, the retardation being practically constant, and at a very high rate. The above figures show the rate to have been 4.6 miles per hour per second, and the initial speed about 18.5 miles per hour.

A further series of tests was made with the same cars on the Manchester road route. The cars were allowed to descend the grade with the track brakes in operation. Five stops were made during the run, using track brakes only, and the time from start to finish of test was noted in each case, as well as approximate speeds and total amperes taken by the brakes:

	B.-T.-B. Brake.	Westinghouse Brake.
Average speed, approximate	7½ m.p.h.	7½ m.p.h.
Total time, including stops	14 min.	12 min. 7 sec.
Total time, exclusive of stops	11 min.	10 min. 42 sec.
Average current, exclusive of momentary stopping currents over 50 amperes	16.68 amps.	19.29 amps.
Average current, inclusive of stopping currents	23.22 amps.	29.28 amps.

Although the British Thomson-Houston readings were more favorable than in the first test, the voltage and amperes were still high.

Now compare the ordinary braking currents with the driving currents on the same hills:

Brakes .....10 to 68 amperes.

Driving .....51 to 90 amperes.

Remembering that motors are designed for driving only it is no mystery why armatures burnt out with the almost double work put upon them. But this is not the only reason why magnetic brakes could not be used for service purposes—they are uncertain in their action, and the tendency to skid a source of danger. With every desire to obtain a service brake, we were obliged to give up the magnetic brake, and we are still on the look-out for a suitable form of mechanical brake to relieve the driver from hand-braking.

The magnetic brake had not been used anywhere under the circumstances of the Manchester road tramway, and with our experience of it on the trunk line it was quite clear an unsuitable brake for the conditions obtaining there. A simple matter of figures will show you how this is. By experiment it has been found that at saturation point the Newell brake magnet can be lifted from the rails at fifteen hundredweight. Now compare this with the weight required to hold eighteen tons on 1 in 9.8—the car must run away if nothing else to depend on.

I now proceed to describe the mechanical track brake, and the way it operates upon the cars which have been working the Manchester road route for a period of two and one-half years with an entire absence of accident.

The hand wheel of the track brake has a diameter of sixteen inches—reckoning fifteen inches centre of rim gives a circumference of forty-seven inches. This wheel operates a screw of one-half-inch pitch (which is provided with a ball thrust to reduce friction), which is connected by pull rods direct to the swing lever in the centre of the car. The gear ratio between the hand wheel and the nut on the screw is 94 to 1. The floating lever in the centre of the car has a leverage of 5 to 3. The connection between this lever and the levers on the trucks is by rod and chain, and is not affected by the radial movements of the trucks on curves. The power is imparted to the track shoes by means of levers having a ratio of 3 to 1. Total leverage, 468 to 1.

The brackets (which are of cast steel) carrying the track shoes and the fulcrums of the levers are attached to the truck frames by means of steel angle and tee bars, which are bolted to the truck frames. The wearing parts of the shoes are of cast iron, and are easily renewed.

The brake is used as follows: on leaving the terminus at the summit the brake is screwed down sufficiently to allow the car to run the proper speed with the hand brakes off; the car is then controlled by the hand brake, which has about the same leverage as the track brake. When the car is stopped the track brake is eased off to allow the car to start, and then screwed down again as before.

For an emergency stop the rheostatic brake is used, and its effect is very efficient and will stop the car at six miles per hour on 1 in 9.8 in three yards or four yards.

Each shoe and lever to the shoe is independent, therefore the failure of one shoe or lever does not affect the remainder. Two shoes only will safely control the car. The track brake alone will bring the car down safely and make service stops, thus being a perfectly independent brake and additional to the ordinary equipment of the car. The shoes are easily changed, and last from ten to twenty-one days according to the weather. The dimensions of the shoes are fifteen inches long by three inches wide, and the wearing depth is one and three-eighths inches. When cast-iron slippers were adopted there were no data available as to the wearing effect upon the rail, but the accompanying section of the rails on the heaviest portion of the gradient clearly show that the wear on

FIG. 4.—WEAR ON RAILS.

the down or braking side is less than the up or driving side.

Fig. 4 illustrates the wear on the rail after two and one-half years' service, and the passage of 81,655 cars.

Practically no sand is used on the down rail, even in greasy weather, and I may here state the meteorological conditions of Burnley are bad, the rainfall being greater than any other part of Lancashire except the lake district; moreover, the subsoil is clay, which accounts for Burnley being such a favorable district for weaving. The brake has recently been adapted to maximum traction trucks under the double-deck cars with equally satisfactory results.

Finally, I submit the following conclusions from our experience: Bogie cars are easier to control on steep inclines than four-wheel cars, whatever the character of the brakes. Magnetic brakes, particularly those which affect the wheel brakes, are unsuitable for tramways either for service or safety purposes. That they can only be considered as auxiliary to the rheostatic brake, and not as independent track brakes. That they are highly destructive to the motors. They are treacherous and uncertain in their action.

The only form of brakes which will safely control a car on gradients greater than 1 in 14 or 15 are: (*a*) hand brake with adequate leverage actuating cast-iron blocks on the wheels; (*b*) mechanical track brakes with adequate leverage provided with cast-iron slippers; (*c*) rheostatic brake for emergencies only.

New Electric Generating Station at Birmingham, England.

The new generating station erected at Summer lane, Birmingham, in connection with the electricity supply of that city was formally opened on October 10. It constitutes the third power-house belonging to the corporation, the others being situated at Dale End and Water street respectively. Both these latter stations are equipped with small units; in fact, although they contain no less than eleven generating sets each, their maximum combined output only amounts to less than 5,000 kilowatts. Such plant was manifestly inadequate for the supply for Birmingham, and the acquisition and electrification of the tramways by the corporation made it urgently necessary to provide a new and modern power-house.

A site was consequently acquired, bounded on one side by Summer lane and on the other by the Birmingham and Fazeley canal, and a power-house erected to the general designs of R. A. Chattock, the corporation electrical engineer. The main building comprises three bays—the engine house, of 100-foot span; the boiler house, of eighty-nine-foot span; and the economizer house, of forty-seven-foot span. Each bay runs the full length of the building, 275 feet. The switch gear is placed at one end of the engine room, and is consequently a considerable distance from some of the machines to be controlled.

The plant in the station has been put down to deal with four classes of supply: (1) A direct-current supply to consumers near the station at 220 or 440 volts, the distribution being on the three-wire system, with 440 volts across the outers; (2) A direct-current supply at 440 volts sent through trunk mains to Dale End and Water street generating stations, for distribution from thence; (3) A direct-current supply at 550 volts for the tramways in the vicinity; (4) A high-tension three-phase supply at 5,000 volts to the substations in the city. Altogether, the first equipment of the Summer lane station will consist of 7,000 kilowatts of direct-current plant, and 4,500 kilowatts of alternating-current plant, though the ultimate capacity of the station will be 13,000 kilowatts of direct-current plant and 13,500 kilowatts of alternating-current plant.

The generating plant now installed, or in course of erection, consists of four Belliss-Dick Kerr 1,500-kilowatt direct-current sets, two Belliss-Westinghouse 1,500-kilowatt alternating sets, three Belliss-Westinghouse 500-kilowatt alternating sets, and two 500-kilowatt direct-current turbo machines, built by C. A. Parsons & Company. The six large Belliss engines are exactly similar, and have cylinders twenty-five inches, 36.5 inches and fifty-five inches in diameter, with thirty-three-inch stroke. The direct-current sets run at 160 revolutions per minute, and the alternating-current sets at one hundred and sixty-six and two-thirds revolutions, the latter speed being required for a frequency of twenty-five to be obtained from the alternators. Steam is supplied at 180 pounds, superheated by 100 degrees to 150 degrees Fahrenheit. The engines are fitted with large fly-wheels, the total amount of stored energy being 3,400 foot-tons for the direct-current sets and 4,600 foot-tons for the alternating-current sets. The governors are capable of keeping the speed within two per cent of normal over a load ranging from *nil* to 1,875 kilowatts, or twenty-five per cent overload. As it is intended to supply power, lighting and traction current from the same three-phase bus-bars, the importance of close governing will be obvious.

The four 1,500-kilowatt direct-current generators built by Dick Kerr & Company, Limited, are compound-wound sixteen-pole machines, having their armature spiders extended and bolted directly to the fly-wheels of their respective engines. They will be run as shunt machines when on the lighting load; but the compound winding can be put into circuit from the switchboard when they are required for traction purposes. The two Westinghouse 1,500-kilowatt three-phase alternators generate at 5,000 volts twenty-five periods. They are of the standard Westinghouse engine-type design, with rotating fields bolted to the engine fly-wheels and excited by two 100-kilowatt General Electric exciters. The minor plant includes two motor-driven balancers of 100 kilowatts capacity for dealing with the out-of-balance current on the local lighting network; and two twenty-five kilowatt three-wire boosters to increase the pressure on the trunk mains to Dale End and Water street. These machines are capable of giving a boost of ten volts in either sense, and of dealing with a current of 2,500 amperes. Each set consists of a motor and two boosters for dealing separately with each side of the three-wire system. Besides these there is a 200-kilowatt motor generator which, together with the balancing and boosting machinery, has been constructed by the Phœnix Dynamo and Manufacturing Company, Limited. This motor generator has been installed for the purpose of supplying the tramway load from the lighting bars during the night, when the traffic is very small. It is intended to install a large battery with a reversible booster to equalize the load on the traction generators.

There are four switchboards allocated respectively to the control of the main generators, the tramway feeders, the trunk mains and the lighting feeders. These boards have been constructed by the British Thomson-Houston Company, and the switch gear is of this company's well-known type.

The boiler house contains ten Babcock and Wilcox water-tube boilers of the "land" pattern, each with a heating surface of 6,182 square feet, and fitted with a superheater of 898 square feet surface. The working pressure is 180 pounds. Each boiler has a chain-grate stoker giving a grate area of 100 square feet, and is estimated to evaporate 24,000 pounds of water per hour with a natural draught of three-quarters inch of water. Coal is received from the private canal basin, where it is thrown from the barges on to a twenty-four-inch band-conveyer. This delivers it into an Ingrey weighing and recording machine. After weighing it is elevated by one of the two bucket-conveyers, and delivered into hoppers in the boiler-house roof.—*Engineering*, October 12.

"Increasing the Standard of Illumination."

To the Editor of the Electrical Review:

Permit me to express my appreciation of your editorial on "Increasing the Standard of Illumination" in your issue of October 20.

In my opinion the present tendency of increasing the intrinsic brilliancy of light sources is one which should be deprecated. I am glad to note that you take the same view of the matter.

In your report of the discussion which took place on this subject at the October meeting of the New York Section of the Illuminating Engineering Society there is an obvious error. Referring to the intensity of illumination given by a ground-glass window on a bright day, you quote me as saying that this might be as low as one-fiftieth of a foot-candle. Obviously, the intensity of illumination in foot-candles would vary according to the distance of the point at which the measurement was made to the window.

What I said was, the intrinsic illumination in the case cited was less than one-fiftieth of a candle-power per square inch, which is far less than that of any of the light sources referred to in the paper under discussion.

L. B. Marks.

New York, October 20, 1906.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Piston Action of the Electrical Air Drill.

The more effective action of the electric air drill as compared with the simple compressed-air drill is explained here by Frank Richards. In the first place it is pointed out that the electric air drill has no valves—that its piston is actuated by the alternate supply of compressed air on each side directly from a small two-piston, motor-driven compressor. This arrangement is a simplification over the usual air-operated arrangement, as all the parts of the drill which usually give trouble and cost so much for repairs are eliminated. The compressors, the author suggests, should more properly be called pulsators, as they have no valves and no water jackets. The more effective blow of the electric air drill is due to the fact that the compressor piston follows up the drill piston and maintains an increasing air pressure throughout nearly the whole stroke, while with the compressed-air drill the pressure is a maximum at the start and dies out throughout the stroke. For this reason the blow delivered by the electric drill is more penetrating. Another advantage of the combination drill is its small liability to sticking. When a compresser-air drill catches, the bit must be loosened by hammering or by means of a wrench. The electric air drill, however, when it catches, is subjected to a rapidly alternating series of pulls and thrusts which nearly always loosen the bit before the operator can get a tool on it. This effect saves a great deal of time by not wasting it—*Abstracted from the Engineering and Mining Journal* (*New York*), *October* 13.

Chemical and Electrical Changes Induced by Light.

For some time past H. S. Allen has been engaged in an investigation of the fatigue shown by metals for the photo-electric effect. He has made a careful examination of the rate at which the photo-electric current decays in the case of a zinc plate polished or amalgamated. A large Nernst lamp supplied with current from storage cells is used to give a steady source of light. The decay immediately after exposure to the light was very rapid, but after about twenty minutes became much slower. For a change taking place according to the "compound interest law," as in the case of a mono-molecular chemical reaction or a purely surface effect, it is known that the curve can be represented by an exponential term involving the time. In the case of zinc the author found that the activity at any instant can be represented with considerable accuracy by the sum of two exponential terms. It is possible to interpret this result somewhat on the lines followed by Rutherford in explaining the decay of the excited activity of radium or thorium by supposing that a succession of changes takes place. Similar results have been obtained in the case of aluminum and also with specimens of colored fluorspar. It is interesting to note that the longer waves of light tend to produce a change in the opposite sense, so that the rapid decay at first observed on exposure to light may be followed by a small increase in activity, unless the long waves are absorbed by a solution of alum. —*Abstracted from Nature* (*London*), *October* 4.

An Electrical Anemometer.

An interesting method of constructing an electrical anemometer is described here by R. Goldschmidt. This device depends for its action upon the cooling effect of a moving current of air. A fine platinum wire is exposed to the wind, and through it is sent a small electric current. The latter heats the wire, thus increasing its resistance, and the final point reached will, if the electric current be constant depend upon the cooling action of the wind. The greater the velocity of the wind the greater this cooling action; and therefore the higher the wind velocity, the lower the resistance. To counteract the effect of changes in air temperature a similar strip of wire is placed in proximity to the other and exposed to the air, but protected from the wind. This strip then takes a temperature depending only upon the temperature of the surrounding air. These two wires form two arms of a Wheatstone bridge, and their relative resistances determine the deflections of a galvanometer connected in the bridge, which thus indicates directly the velocity of the wind. To calibrate the apparatus the exposed wire is supported by a vertical rod carried on a disc revolving about a vertical axis, the rod being placed somewhat eccentrically. By revolving the disc at various speeds it is possible to produce the effect of any wind velocity, and thus to calibrate the apparatus. The practical type of instrument is mounted on the weather vane, the one wire exposed to the air and the other protected from it. Both are protected from rain. The same device, as it turns, varies the position of a small brush on a horizontal circular wire resistance. This variation of position, by changing the resistance connected in a suitable circuit, indicates the exact direction from which the wind is blowing.—*Translated and abstracted from the Bulletin of the Société Belge d'Électriciens* (*Brussels*), *September*.

Determination of the Points of Transformation of Certain Steels by Means of the Electrical Resistance.

A brief summary is given here of an experimental research by P. Fournel into the relation between the electrical resistance of steel and the modifications of structure caused by a change in temperature. The resistivity of a steel submitted to an increasing temperature shows sudden changes at those temperatures which produce modifications in the constitution of the steel. This seems to offer a means of watching closely the behavior of steel due to temperature changes. In this particular investigation eight samples of steel were studied. These were in the shape of wire about 0.3 millimetre in diameter and thirty centimetres long. The wires were wound on a double tube of mica and heated within an electric resistance furnace. The resistance was measured by placing each sample in series with a standard ohm and passing through it a current of a few hundredths of an ampere. The fall of potential was measured by means of a potentiometer. The temperature was determined by means of a Le Chatelier thermocouple inserted between the two layers of mica. The temperature resistance curves plotted in this way showed discontinuities which enabled the author to identify the temperature at which the cementite is dissociated, and the transformation from the α state to the β, and

from the β to the γ. The temperatures at which these transformations occurred were different for the different samples, due to the different constituents which they contained. Cementite is dissociated at from 670 to 695 degrees centigrade. The change from the α to the β state took place at temperatures varying from 740 to 780 degrees. The presence of manganese influences this point greatly. The final transformation from the β state to the γ takes place at temperatures from 790 degrees to 880 degrees.—*Translated and abstracted from La Revue Électrique (Paris), September* 15.

The Value and Design of Water-Power Plants as Influenced by Load-Factor.

The effect of the load-factor is of great importance in determining the value and design of water-power plants. This is true also of steam plants, for it is difficult, says Dr. F. A. C. Perrine, to reduce the coal consumption to less than five pounds per kilowatt-hour, even with the most economical equipment, if the load-factor on the station be only thirty per cent. But this matter of load-factor often affects the hydraulic plant more seriously than the steam plant, though it is true that the adaptation of plan to load-factor is more often controllable in the design of the hydroelectric plant than in the design of the steam plant. When the load-factor is less than unity and a stream providing no storage is furnishing the energy, energy is wasted whenever the load is less than the maximum capacity of the stream. With sufficient storage a load-factor of less than unity may be served without waste of hydraulic energy, but sufficient storage to care for a load-factor of less than sixty per cent is rarely obtainable in large plants where the head is less than about 100 feet, because the quantity of water becomes too great to be stored in available basins. A correlative solution of this problem of design is found in the selection of the load itself. The problem of design then becomes one in determining rates, and is one which concerns indirectly the engineer as much as the design of the power-plant itself. After all has been done that is possible in obtaining the best possible storage it is often the case that there remains a residuum in the problem which may be economically handled only by steam or gas auxiliaries. The legitimate field for these expedients is now well recognized, and no hydraulic plant should be studied without giving them due consideration. In many cases of plants which have been installed the revenue is based upon an assumed load-factor of unity, and a charge for current made on the basis of the maximum customer's demand. This method of charging requires a rate lower than might be obtained by a different method of charging, since only those customers who can control their load-factor to a value close to unity can afford to enter into such a contract, and it is only justifiable where no means can be provided for handling a variable load-factor in the plant and where sufficient customers for utilizing all the power furnished by the plant can be obtained. An unsuitable load-factor is not necessarily one of low load-factor, but is one in which the curve of the load is different from the possible curve of output. Where the engineering of both plant and load can make the load curves correspond exactly the greatest possible output and revenue can be obtained from the plant. The common method of evaluating a water-power plant is to state its cost or value in terms of dollars per unit of capacity. This method of rating is only suitable where the supply possible from the plant is at a constant rate and the load-factor of the customers is unity. It is, in general, very false to reckon the value of a plant upon any other basis than that of its maximum output in kilowatt-hours, which is the true method of reckoning cost and determining the relative value of water power and other sources for obtaining power. A considerable number of plants already installed are valued solely on a basis of capacity, and they are charging their customers upon a maximum-demand rate. In a number of these cases an increase might be made in the revenue if a rate somewhat dependent upon the customer's load curve were adopted. The maximum-demand rate for charging is a low rate for charging and, in consequence, the valuation of a plant upon the basis of its capacity alone results in an undervaluation of a large proportion of hydroelectric opportunities. The true method of evaluating a hydroelectric plant is dependent upon its competitive value in the territory, and this requires that it be done upon the basis of the total number of kilowatt-hours which may be generated and sold. It is not reasonable to develop a hydroelectric station when a steam or gas station could be built which would supply the same territory at a less amount of cost, but it is also unwise to condemn a hydroelectric development because the cost per unit of capacity is high, when, at the same time, it can develop cheaper power than can be done in any other manner.—*Abstracted from the Journal of the Franklin Institute (Philadelphia), October.*

The Power Plant for the Simplon Tunnel.

In this description of the electrical equipment of the Simplon tunnel railway some particulars are given regarding the two power-houses for supplying power to the railway. The station at Brigue contains two Escher-Wyss hydraulic turbines fed by water from the river Rhone, the water being conducted to the power-house by means of canals 5,000 feet long. Each turbine is rated at 500 horse-power and rotates at a speed of 160 turns per minute, the effective height of the fall being about 140 feet. Both turbines are mounted on one shaft, to which is coupled a 1,200-horse-power, three-phase alternator. This machine delivers current at 3,300 volts, 160 cycles per minute, and is of the revolving-field type. The two turbines are not equipped with any regulating device, and it is necessary, in the absence of a governor, to adopt a special arrangement in order to avoid dangerous rises in speed when the load goes off the generator. The plan adopted is to maintain constant full load on the alternator, which is accomplished by means of a liquid resistance which regulates automatically the output of the machine. This regulator consists of a tank of concrete, in which are plunged two iron electrodes. An automatic device controls the position of these electrodes in the liquid and in this way maintains the load constant. The switchboard at this station is very simple, and consists of three panels, one of which contains the regulating and measuring apparatus; one, the generator appliances, and the other the light and power for the station. A circuit-breaker is placed in the main generator line. The Iselle station utilizes the water of the Diveria river, and is very differently planned from the other station. The effective head of water is about 450 feet. Two centrifugal turbines, each rated at 750 horse-power and revolving at a speed of 960 revolutions per minute, are installed. These two turbines are coupled to the two ends of the shaft of a high-speed alternator. The construction of the latter resembles that adopted for the steam-turbine drive. The whole group is carried on two bearings and is lubricated by oil circulated under pressure. The speed of the turbines is controlled by a very sensitive governor which actuates the regulating mechanisms by means of oil under pressure. Each station supplies one section of the tunnel, but the two lines may be coupled together at the centre if this becomes desirable.—*Translated and abstracted from L'Éclairage Électrique (Paris), September* 29.

Street Railway Week at Columbus, Ohio. Convention of the Railway, Engineering, Accountants and Claim Agents' Association, and the Manufacturers' Exhibition, October 15-19.

American Street and Interurban Railway Engineering Association.

MONDAY MORNING SESSION.

THE first session of the American Street and Interurban Railway Engineering Association was called to order Monday morning, October 15, at 11:15 o'clock. The meeting was held in the central convention hall, which forms building No. 5 of the exhibition buildings at the State Fair grounds.

President H. H. Adams, of Baltimore, Md., introduced E. C. Spring, president of the Central Electric Railway Association, one of the principal offsprings of the American Street Railway Association, which was started in 1882. Mr. Spring addressed the meeting briefly in behalf of the street railway men of the middle western states.

The next speaker was James H. McGraw, president of the Manufacturers' Association. Mr. McGraw, in behalf of the manufacturers, outlined the work which had been done with a view to completing the details for the immense exhibit, and pledge the support of the manufacturers in the work of the reorganized association.

John I. Beggs, first vice-president of the American Street and Interurban Railway Association, then addressed the convention. Mr. Beggs stated that, in his opinion, the engineering association was the one upon which depended, in great measure, the success of the affiliated associations. The men who, all along the line, are doing the work—the masters of way and the engineers—are those upon whom the managers must depend.

President Adams then delivered his annual address. He called attention to the work of the executive committee of the parent association, and outlined the steps which have been taken toward reforming and reorganizing the affiliated associations. He called particular attention to the work that had been accomplished through the standing committees, and asked for concentration on the subjects of standardization and insurance. The standardization committee, he said, has been doing a vast amount of work, but it is not the intention of this committee to solve the problem in one jump, but to attack each problem in a systematic manner, in order to lay a firm foundation upon which to work. The committee has met with a liberal response from the various roads, but it is hoped in the future that the response will be even greater. At the present time it has under consideration the brake shoe, wheel tread, flange, journal, journal box and rail section.

W. B. Brockway, president of the Accountants' Association, then addressed the convention briefly, after which the report of the executive committee and the reports of the secretary and treasurer were read.

A committee on resolutions, to consist of G. J. Smith, Kansas City; Charles Hewitt, Philadelphia, and E. W. Olds, Milwaukee, was appointed.

The meeting was then adjourned.

MONDAY AFTERNOON SESSION.

The Monday afternoon session was called to order by President Adams at 2.10 o'clock. The Hon. W. Caryl Ely, president of the parent association, was introduced. Mr. Ely made an earnest plea for concentration along the lines of reorganization. He pledged the entire support of the operating companies, and expressed his appreciation of the manly way in which the engineers had taken hold of every problem which had confronted them. He counseled moderation in all things, and emphasized the importance of each of the representatives of the companies taking back to their home places the evidence that attendance at the meetings was a source of instruction, and that in no direction could the expenditure entailed be considered wasteful.

President Adams thanked Mr. Ely in the name of the association for his remarks, and then called for the report of the committee on control apparatus. This was presented by J. S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York city, as chairman of the committee. This report was devoted mainly to notes on the use of multiple-control. Both the General Electric and the Westinghouse companies have continued to develop this type of apparatus in respect to the reduction of weight and the number of parts. The pressure allowable between the contact points of the switches has also been materially increased. This latter development may be said to be the greatest improvement accomplished. Progress has been made by each of the manufacturing companies on control apparatus for heavy railway locomotive work. Single switches having a capacity of from 1,000 to 2,000 amperes have been developed, but inasmuch as these locomotives have not as yet been placed in regular service, this subject will have to be deferred until the next meeting.

G. J. Smith, Kansas City, stated that the Metropolitan Street Railway of Kansas City has in service and has had for three months past, thirty cars, thirty feet seven inches over corner posts, with type M multiple-unit control operating as a single unit. From present indications the results will be so far superior to the platform controller, that the management is considering installing the type M control on 120 of the same type of equipment, and doing away with the platform control; that is, from the standpoint of panics created by controllers operated on platforms.

At times the motors are taking 800 amperes at 575 volts, and the average amperage on the Troost avenue division is 153, on ten seconds' reading. That current is too heavy to handle on the platform without danger of having not only the automatic openings, but the controller short-circuiting and causing a panic on the car.

E. W. Olds, Milwaukee, stated that the Milwaukee Railway and Light Company last year put into service fifty cars with the contactor in series. The contactor itself, in throwing off the current, opens a little ahead of the controller. The cars first equipped with the controllers caused a little trouble on account of mechanical defects in the construction of the control circuit-breaker but this has been remedied. Should a short-circuit occur in operation on any platform controller, the motorman can at once throw his handle to a position which stops the fireworks. The work that has been done by the manufacturers to reduce the size of the type M and pneumatic control has been very satisfactory.

His company is also placing individual fuses for each motor; should a short-circuit occur on any one of the motors, the fuse protecting that motor would blow. With the old type, very often, should a short-circuit occur, the arc would start, which, on account of the resistance, would cut down the current so that the circuit-

breaker main fuse would not blow, but the fireworks would continue.

H. H. Adams added a word in connection with the same type of control. The first part of the year his company put in service forty four-motor equipments on cars that are thirty feet eight inches over corner posts, weighing about 49,000 pounds, with four sixty-five-horse-power motors. At the same time they put in service 160 equipments of four-motor cars, weighing about 45,000 pounds with four forty-horse-power motors. These equipments had the K 28-b control, the first having type K 28-f control. They have had excellent results with the K 28-f, or the contactor combination. The cars have been in fairly heavy service during the past summer.

F. E. Case, of the General Electric Company, Schenectady, N. Y., said he believed the so-called multiple-unit control is well adapted to cars say of 200 horse-power or thereabouts; above this size the ordinary cylinder control becomes somewhat bulky. The chief claim for the control is that it is located under the car. It not only provides a greater factor of safety so far as not arcing, or anything of that sort, causing actual damage, but it also removes the arc to a point where the passengers will not notice it, should any such arc occur. In connection with the type K 28-f controller in which contactors are used under the car some cars have been equipped in addition with an automatic switch or circuit-breaker located in the vestibule, which will open the control circuit when an excessive current flows. This will permit the contactors to drop and operate as a circuit-breaker. At the same time, these contactors operate each time the controller is turned to the first point. In many of the equipments which have been furnished, not only does the control open on the first point, but also during the transition from series to parallel in the multiple-unit control both for single cars and for trains. His company has been working along the line of securing more efficient apparatus and has succeeded in increasing the pressure at the contacts.

Paul Winsor, Boston, Mass., stated that the Boston Elevated is experimenting with two cars coupled together, using an extra set of contacts, extra contact plates in the reversed circuit on the off position. The two cars are coupled together permanently with a slide draw-bar, which does away with the scrapers and platform controllers between the cars; and with the extra set of plates on the off position of the controller, they are enabled to control from the front platform two motors on each car with three wires between the cars. The multiple controllers are giving very good satisfaction.

President Adams asked Mr. Case if he had been able to get the multiple-unit control reduced in size and weight for the single car equipment.

In reply Mr. Case said the weight has been gradually reduced during the last few years. With the very early equipments the contacts were brought to about twelve inches space, with thirteen contacts. This was finally cut down to less than one-half, and all of the contactors were placed in three boxes as a first step. As a next step, all of the contactors were placed in a single box, completely wired up ready for installation. This did not materially reduce the weight, however, except that there was no necessity for providing cleats on the bottom of the car for supporting the wires; the wiring itself was greatly reduced on that account, and the expense of installing also went down.

William Cooper, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., said he quite agreed with the remarks made by Mr. Case in regard to the general subject. The point of getting all of the higher voltage wiring, all the main circuits, under the car and keeping them off the platform, seems to be the main consideration. His company has developed a controller which is small enough to go on almost any car. It has a capacity of two 100-horse-power motors, or even more. It is calculated to run it up to about 300 horse-power total. A controller sixteen inches long, fourteen inches wide and about fifteen inches deep weighs from 300 to 325 pounds. This seems not to be an excessive weight or size for almost any car that it might put it on. Of course there are some considerations which go with it as far as location is concerned. For smaller equipments, a switch screw, as it is called by itself, is used. For larger equipments, when they run up to, say, four seventy-five-horse-power motors, there is added what are called line switches for safety, and also as a part of the combination in the controller circuit. The largest installation made with that size controller is four ninety-horse-power motors. In that case two separate line switches are used and they are of about the same general construction, with one switch in each box, and weigh sixty pounds apiece. There seems to be quite a demand for control apparatus to go under cars for all sizes of equipment, and, of course, it will have to be met.

The next paper, entitled "Ties, Poles and Posts," was read by C. A. Alderman, chief engineer, Cincinnati Northern Traction Company, Cincinnati, Ohio.

Ties constitute nearly one-third the total cost of the material for the construction of the modern interurban track, exclusive of ballast and roadbed. Their selection and use is therefore a matter of special concern from the fact that their life is short and constant renewals must be made. Poles are of somewhat less, although of very great, importance in the make-up of the material account of the road. Posts for the road built on a private right of way form quite an important item in the cost of construction and maintenance. The author gives the specifications for standard cross-ties worked out by the Cincinnati Northern Traction Company. Ties purchased under these specifications are costing from sixty-five to seventy cents delivered at convenient shipping points in Ohio and Indiana. Tie inspectors are located at the shipping points, and all ties are accepted and classified before shipping. The greater part of these ties come from Kentucky, and some from southern Idaho. The chemical treatment of ties with preservatives is becoming an important industry in the United States. Tie preservation is to-day being scientifically investigated and practised by nearly all of the leading steam railroad systems of this country. The various methods for the treatment of ties are as follows: creosote, chloride of zinc, zinc and tannin, and zinc and creosote. The treatment of ties with creosote of the dead oil of tar is acknowledged by all authorities on the subject to be the best, but it is also the most expensive. The author's experience with fence posts has been that a good grade of red cedar is about the best that can ordinarily be obtained. Black locust is said to be, and undoubtedly is, the best timber that can be found for posts, but it seems to be a hard matter to get it. Concrete for ties, poles and posts has been proposed and used to a limited extent by a few. The author's own idea is that concrete is not very well adapted for use as a railroad tie, but he sees no reason why it should not be a success in trolley poles or fence posts. The greatest objection to the concrete post is its weight. Concrete posts have been used to quite an extent and are no longer an experiment. Undoubtedly steel cross-ties will be used to quite an extent as soon as timber advances in price, say, ten or twenty per cent. There are now in the United States about 200,000 miles of railroad, which with second track, sidings and yard tracks all added, will aggregate over 250,000 miles. This 250,000 miles of railroad requires 660,000,000 ties. The average life of a tie untreated is not over eight years. This means that 82,000,000 ties are required annually for renewals, or the timber from half a million acres of forests.

F. G. Simmons, Milwaukee, Wis., said that the life of a wooden trolley pole is dependent almost entirely on the action of decay at the ground line, and he thought that if a post is subjected to a preserving process which will carry to or slightly above the ground line, the objection as to its conductivity from the trolley down will be overcome. In Milwaukee they are setting poles in concrete, right straight through, and in placing the concrete it is brought to or a little above the ground line, with a collar two or three inches in depth and about an inch in thickness all around the pole where it projects above the ground, forming a channel which is later filled with paving cement or tar mixture.

A. B. Lambe, Toronto, described some concrete pole work being done at St. Catharine, Ontario, where there is a very deep valley running through the centre of the town across which a 20,000-volt line is going. In order to save going down and following the contour of the ground it was decided to put up two 150-foot poles, built of reinforced concrete. The poles are, roughly, about two feet square at the base and taper with a slight bevel on the corners, and weigh somewhere about fifty-five tons apiece. They were

built on the ground horizontally, and then raised by means of a derrick. The first one was broken putting it up because they did not pick it up at enough points, but they remedied that afterwards. Two poles are now up and so far are doing very satisfactory work.

G. H. Kelsey asked for information concerning the probable life that is being obtained in traction work from cedar poles, seven-inch, forty-foot, spaced possibly 100 feet apart. He has several miles of such construction that is now six or seven years old and several miles which is two or three years old. In figuring a steel tower it is quite important to know how long the cedar poles are lasting or how long they will last.

In reply G. F. Smith stated that during the past summer he replaced nine miles of white cedar poles, spaced 100 feet apart, that had been in service thirteen years. That is in the western end of Missouri.

F. G. Simmons stated that he has about ten miles of road in which the poles were placed between eight and nine years ago, white cedar poles, spaced a little over 100 feet apart, and on a recent inspection about six or seven per cent of them only showed a necessity of replacement on account of rotting at the ground line. These poles were placed without any protection at the base. He has another line, much shorter, in which the poles were placed without protection at the base, and these poles show no deterioration at the ground line after eight years.

E. J. Dunne stated that with good sound first-class cedar poles, the average life would run from fifteen to twenty years. He has taken them out of the ground when they were twenty-five years in service, and found them in fair condition. That would not apply, however, to street railroad work, but this refers to poles on telegraph lines. It may not be safe to let them stay that length of time for side pole suspension, but it is safe to say that one could get good white cedar poles which would be good for fifteen or twenty years. In other words, the wooden pole is double the life of the iron pole. That is his experience. He has had some experience with the concrete butt, and thinks it is all right for bracket suspension. A good pine pole, with a concrete butt, he thought would be a good substitute for cedar.

The paper entitled, "Ballast," was read by Charles H. Clark, engineer of maintenance of way, Cleveland Electric Railway Company, Cleveland, Ohio.

The author describes particularly the method of ballasting used by the Cleveland Electric Railway Company. In Cleveland the greater portion of the underlying foundation is composed of sand, some of which contains a large percentage of loam. In the sandy streets, before laying the tracks, the trench is puddled. This is done by building earth dams and flooding the trench with city water. As a general rule this will cause a settlement of the original earth of from three to six inches. In clay and shale, where sewers have been constructed and the tracks must be laid immediately, the practice is to excavate the clay or shale to a greater depth than will be needed for ballast and partly fill with sand, and then cause the sand to be settled into the voids by liberal use of water. The simplest way of tamping track is to use the material thrown out of the trench. Tamping bars are used on gravel and sand, and tamping picks on broken stone. Tamping bars are also used on concrete under the ties and under the rail. Another type of construction used by the Cleveland City Railway Company previous to 1903 was to lay four inches of concrete on the bed before laying the ties. This was then covered with one inch of sand and the ties tamped with the sand. The space between the ties was then filled with concrete and sand laid on top for the paving bed. Steel ties have been used with great success by the Cleveland company on some of the heaviest lines. The Lorain Steel Company's ties were laid every ten feet, alternating with a wooden tie spaced the same distance. Eight inches of concrete was laid under the steel ties and four inches under the wooden ties, and a beam ten inches deep under and along the rails. The author considers that the steel tie laid in concrete is cheaper than the white oak tie laid in concrete or broken stone. This is on the assumption that white oak ties cost eighty cents apiece. The life of the steel tie can be placed at twenty years, and the white oak at about twelve years. In repairing old tracks the author has found that the concrete which has been laid for four or five years was very poor. It has been his practice not to make any but first-class one-three-six concrete. This may cost more than the concrete that would pass city inspection, but in the long run it will be found that the best is none too good for the company. In conclusion, the author recommends that drainage pipes be placed in clay soils and in all wet, sandy soils, and that when the traffic can be kept off the track that a solid foundation of concrete, made in the proportion of at least one-three-six, with best Portland cement, be used. The concrete should be brought up to within one inch of the bottom of the pavement. The first cost of this foundation may seem large, but the annual maintenance cost thereafter will be greatly reduced.

F. G. Simmons said that he believed that in using concrete construction the twelve years ordinarily designated as the life of the cedar tie has been overcome; that the concrete preserves the wood of the tie whether white oak or cedar, to such an extent that its life becomes almost indefinite. He has taken up track that has been laid under almost similar conditions to that described in this paper, where the cedar ties have been in sixteen and eighteen years, and placed back into the construction anywhere from forty to sixty per cent of the same ties, encased again in concrete.

C. A. Alderman said that in central Ohio during the past few years they have been inclined to believe that concrete under ties was not the best thing to use. It is his belief regarding the situation as affecting interurban traffic. He feels that concrete under ties is an almost impossible proposition from the standpoint of getting good permanent track. The different companies he has been connected with have been quite uniform in their conclusion that a well-ballasted track with something besides concrete was the best thing either in city streets or in the country. They lay the concrete wherever necessary, of course. Concrete for heavy interurban cars weighing 70,000 pounds, and going at a high rate of speed, is not an easy thing to get in in such shape that it will not break up, and when it breaks up it becomes loose, disintegrates, and it is not much better than using so much ashes under the track. It is a very hard thing to get a track laid with as little as six inches of concrete under the rail, and have it so that it will stand the traffic of interurban cars coming into the city. Several cities in this neighborhood have specified gravel and broken stone for ballast, and have discarded the concrete. The city of Dayton allows nothing but T rail, with gravel or broken stone ballast. Indianapolis is not quite as pronounced as that, but they are laying a great deal of track there with gravel and broken stone ballast. They are starting it now in Columbus, although they are not allowing the two things to go in at the same time—if you lay T rail they tell you to put in concrete ballast. If you lay girder rail they will sometimes allow gravel. The city of Cincinnati is experimenting with track laid on broken stone ballast and nearly all of the smaller towns through which the interurban cars pass are allowing gravel ballast to be used instead of concrete.

C. H. Clark asked Mr. Alderman what the proportions are in the concrete he used in Columbus.

Mr. Alderman gave the proportions 1-2½-5, Portland cement, the city specifications being one-two-four for natural cement, and one-four-eight for Portland cement.

Mr. Clark stated that he had had a great deal of experience in the use of concrete, having built a large dam sixty feet high, and that had stood well, and the proportions were one-three-five. He does not believe concrete will be pounded up if the right proportions are used. If concrete is made carefully it will not disintegrate.

E. B. Kirk, of Oshkosh asked Mr. Alderman if he believed in using thin gravel to fill the voids in his crushed rock and whether he had found in using crushed rock of one and one-half-inch size, the subsoil does not work up into the void?

Mr. Alderman said the only cases where he has had to use broken stone has been in the northern part of the state. All through the central and southern part of Ohio excellent gravel is secured and it is considered as good or better than broken stone. If it is absolutely necessary to use broken stone he thought the idea of using gravel with it is very good. The usual thing is to use broken stone where gravel can not be found and use gravel where it is found. Any ballast, of course,

is liable to mix with the soil underneath it, and that is the great trouble with the road, to keep it so that the ballast will stay there after it is placed there. In a well-ballasted track, however, in city streets, he does not find that the gravel or broken stone pounds down into the soil as much as it does on grades outside.

F. G. Simmons said that while admitting the force of Mr. Alderman's arguments as to using a loose ballast, he believed that the efficacy of a concrete ballast is a matter of workmanship. He has had construction six inches under the ties, filled up between the ties and up to a point where the pavement is superimposed with an inch cushion of sand on the concrete, that has been in nine years, and it has not been looked at. He tries to have his concrete mixed of a combination of one part best Portland cement, two and one-half parts of sand, and five parts of rock, and with this mixture and keeping the cars and all traffic off of the tracks for six or seven days, so that the concrete will have enough time to properly settle, there will be no trouble with the construction afterwards. That also presupposes the proper treatment of the foundation below the concrete. He excavates on city streets, and digs a trench; rolls the foundation with heavy rollers, or tamps it with tamping bars, or floods it and is sure the foundation has settled to as great an extent as it is possible to make it before the concrete is superimposed on it.

The report of the "Committee on Maintenance and Inspection of Electric Equipment," was read.

The reliability of operation and economy in maintenance of electrical equipments are dependent primarily upon the selection of apparatus to meet the conditions of service. The committee's report consists principally of a description of the system of maintenance and inspection introduced by the engineering staff of the Interborough Rapid Transit Company, New York city. This company is to be credited with taking the initiative with respect to reducing fire risks on electrically equipped cars, both in semi-fireproofing the wooden type through the use of composite board and asbestos, and also in providing an all-steel type of car. The company has introduced a merit system among the shop force, which has reduced the cost of labor 31.7 per cent on the Manhattan division and twenty-nine per cent on the subway division. This system provides for an itemized comparison of the cost of labor and material among the five inspection shops each month, together with a bulletin showing the number and character of delays to service, from all of which the ability of the various foremen and inspection force is determined. The object of this is to constantly maintain an efficient inspection force. The most competent foremen receive an increase in salary, and the incompetent are either decreased in rank or dismissed from the service. The inspection and overhauling of equipments have both been placed on a mileage basis. The old method was to inspect the cars every three and one-half or four days. Upon investigation this was found to give an average of 450 miles per car. Through a series of experiments it was found that this mileage could be increased to 1,000 without affecting the reliability of service. The average mileage of general repair cars in service during a period of from twelve to fourteen months under the old system was found to be 53,000 miles, and the maximum 90,000 miles. It was decided to adopt an average of 65,000 miles between general repairs. The items of oiling motors, journals, compressors, etc., together with the wear of carbons, brake shoes and other parts, are based on mileage comparisons. In addition to these alterations the Interborough company is at present experimenting with a piecework system for the purpose of providing a means for increasing the employés' wages, thus obtaining a better class of men and also effecting further economies. So far this has proven very satisfactory, for the amounts paid the employés affected have increased on an average ten per cent, while the cost of the work has been reduced twenty-six per cent.

Mr. Winsor in reply to a question concerning the recording of mileage, said that on the surface cars he has the night starters at the various stations keep the mileage. They use the register sheets for that purpose. His fare register sheets are made up by car numbers, following that car through the various routes that it runs during the day, so that by knowing the number of trips it ran on each route and referring to a mileage table of routes, he can very easily make up the figures. Then, he carries, by a system of cards, the car number on a car. He enters down each day the mileage made that day and the total to date, and sends those cards every morning to the car-house foreman, having checked on each card the cars that have run about the mileage or run up to the inspection mileage.

J. S. Doyle stated that on his equipment the armature bearings are oiled every thousand miles irrespective of time and the motor axle and journal bearing are oiled every ten thousand miles.

TUESDAY MORNING SESSION.

President Adams called the meeting to order at 10.20 o'clock on Tuesday morning and requested J. M. Larned, Pittsburg, Pa., to read the report of the "Committee on Standardization."

After a careful consideration of the subject it was decided to confine the work of the year to the standardization of brake shoes, flange and tread of wheels, rails, journals and journal boxes. Data sheets and circular letters have been sent in duplicate to over 800 street and interurban railway companies, to be filled out and returned with accompanying drawings and sketches. A considerable number of the data sheets on brake shoes and on flange and tread of wheels have been filled out and returned with sketches and suggestions as to proposed standards. A number of the data sheets relating to rails and to journals and journal boxes, together with accompanying drawings and sketches, have also been received, although it was not practicable for the committee to issue these data sheets before the middle of September. The information obtained by means of these various data sheets must be carefully collated and summarized in order to make it practicable for the committee to properly use them. The drawings and sketches must also be studied and new ones made up which embody the recommendations of the various companies. This means a large amount of detail work on the subjects now under investigation, which must necessarily devolve upon the standardization committee during the coming years. It therefore does not appear to the committee to be advisable for the association to undertake much new work in the standardization of equipment at the present time. The committee recommends that the association decide to add the standardization of motor parts to the work of the Standardization Committee for the coming year. It is also the desire of the committee to emphasize the necessity of standardization of equipment. Owing to the extensions and consolidations which are constantly taking place in the various railway systems, an interchange of cars and equipment will ultimately become necessary, and it is the hope of the committee that the companies which have not already returned the data sheets will give them prompt and careful consideration.

Fitz-William Sargent stated that as a manufacturer of brake shoes, he has had some experience in the various designs of brake shoes that are used throughout the country and it is very evident that there is a tremendous waste and expense incident to the present practice in regard to brake shoes. He referred particularly to the difference in patterns. A large number of roads use the combined head and shoe, weighing all the way from thirty to fifty pounds, and scrap it when less than half worn out, and that is a loss, especially where high-priced shoes are purchased.

There are a number of roads in this country, principally in the west, which are following closely into the lines of the steam railroad practice, and are using a separable head and shoe known as the Master Car Builders' Standard in steam practice, and that is in the line of the greatest economy in brake shoe maintenance because that shoe has the metal so disposed that you get the maximum material for wear and the minimum for scrap.

The secretary read a communication from the Central Electric Railway Association recommending the following standards:

Brake Shoes—We recommend the adoption as standard of what is known as Master Car Builders' standard type of brake shoe, brake head and key.

Journals and Journal Boxes—We recommend the adoption as standard for journals and journal boxes the Master Car Builders' adopted standard so far as applicable to motor trucks for axle journals, known as 3¼ x 4¼ x 8 and 5 x 9. We further recommend the adop-

tion as standard for these different sizes of axle journals the Master Car Builders' adopted standard journal boxes, journal bearings and journal bearing keys.

Tread and Flange of Wheels—We recommend the adoption of a wheel-tread three inches wide with flange seven-eighths-inch high and one and three-sixteenths-inch thick at the throat for both city and interurban work.

Rails for Street and Interurban Railways—We would recommend the adoption as standard of what is known as the "T" form section of rail for both city and interurban work.

President Adams suggested that the matter be turned over to the committee and there was no objection.

Thomas K. Bell, Philadelphia, Pa., said that as a matter of fact and record, we are to-day using from five-eighths to three-fourths-inch depth of flange and a greater depth; in other words he should say that the average flange throughout the street railway proposition in this country is very close to seven-eighths depth. Along with that there is possibly only four or five girder rails that are rolled by the combined girder mills of the country to-day, that are really suitable for a flange any more than three-fourths-inch in depth. If the gentlemen will stop to consider that part of the proposition, they will find that the question of wear, the life of the rail, brings the head of the rail close to the trams in a very short time. As a tram rail, there have only been one or two sections placed in the market within the last year or eighteen months. In regard to the question of guard-rails, there is not a guard-rail to-day rolled that will accommodate a seven-eighths-inch flange in a forty-two-foot six-inch radius, with a seven-foot six-inch wheel base, without planing that groove. That has brought on the buyers an additional expense. They pay more for their special work, the cost of the planing of the rail, and the rails themselves are destroyed after having the original rolling scales planed off. There is to-day a crying necessity on the part of the street railways of this country to get together on the question of the adoption of a suitable design of rail, and insist on the rolling mills of this country getting them out. That is one of the most urgent things.

After considerable further discussion President Adams appointed a committee to get up resolutions and submit them on Wednesday afternoon, this committee to consist of Paul Winsor, G. J. Smith, W. H. Evans, Thomas K. Bell and John S. Doyle.

The next paper, "Gas Engines", by Paul Winsor, chief engineer, motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass., was read.

This paper deals with the experience of the Boston Elevated Railway Company in operating two gas engine substation plants. The author considers that a gas engine will hold its efficiency much better than a steam engine. The water required is considerably less for a gas plant than for a condensing steam plant, and considerably more than for a non-condensing steam plant. The only two serious troubles have been premature explosion and back-firing in the engines and noisy exhaust. Both plants are small, one of 700 kilowatts, and the other of 975 kilowatts capacity. Both equipments are operated on producer gas, and the average engine load-factor has been about seventy-four per cent. As a result of the author's experience with these plants he is convinced of the economy and reliability of a gas-engine power station. The fuel consumption will be about one-half as compared with a steam plant, running from 1.5 pounds to 1.75 pounds, according to the load-factor, and almost regardless of the size of the plant. The cost of the gas plant, including producers, is undoubtedly considerably higher than the cost of a similar-sized steam plant, and whether the fuel saved will justify the increased capital depends on the price of coal; but it seems that with coal at $3 and upwards per ton there will be a material net saving by the use of gas.

After reading his paper Mr. Winsor discussed in detail the securing and utilizing of various characters of fuel gas. In reply to a question concerning regulation Mr. Winsor stated that with the direct-current apparatus he used there had been no difficulties whatever.

H. M. Benghler stated that he had operated a 1,400-horse-power, four-cylinder gas engine very successfully with a three-phase, sixty-cycle alternator. In parallel operation with a steam unit there was no trouble.

Edwin Yawger suggested that the whole subject seems to line up in this way: That gas engines are at the present time to be looked upon as desirable in special locations; where coal costs $3 and upwards per ton, where water is scarce and other conditions like the saving in copper, etc. Of course the cost per horse-power of the gas engine is bound to be a good deal more than the cost of a steam engine unless we learn to make gas engines a great deal lighter per horse-power than we do now. The weight in a large engine will run about 500 pounds per horse-power and the price of coal seems to be about the same as it has been and the cost of labor is not getting cheaper, so that he does not see where there is going to be any great thing in that unless it is in a change in design.

The next paper, entitled "Underground Cables," by Henry G. Stott, was read.

Higher voltages than 25,000 have not been attempted as yet in underground cables, but there seems to be no reason why a voltage of 44,000 should not be used with exactly the same degree of safety as 25,000, provided a star-connection be used in the transformers and the neutral point be grounded, for then the maximum strain is limited to 25,000 volts to ground. For economic reasons rubber insulation is used only where local conditions seem to demand an insulation which is impervious to moisture, so that in case the lead sheath should be punctured the cable will not necessarily fail. As an instance, where cables have to be installed in ducts which are under water part of the time, or for submarine cables, the extra investment for rubber insulation would seem to be justified, as in the event of a leak in a submarine cable lead sheath it usually becomes a total loss if insulated with paper or other non-moisture-proof material; whereas good rubber will last indefinitely under water. For potentials above 22,000 volts it seems likely that some form of varnished cambric or impregnated cloth will take the place of paper, owing to its higher puncture resistance for a given thickness. But experience with working pressures above 22,000 volts is so limited that we must wait for some time before any definite conclusions can be reached. The most satisfactory solution of problems of avoiding electrolysis and saving the lead sheaths of cables from destruction seems to be in the use of an insulated negative bus in the power-house and substation, and insulated negative feeders right up to the track rails. For this purpose the negative feeder should preferably be insulated with some material which does not require the use of a lead sheath. The ideal solution of the problem will be found in the use of feeders without lead sheaths, and such tests are now being made on experimental lengths of 650-volt cable of this type; but it does not seem probable that any cable can be constructed at present which will safely stand being drawn into wet ducts and manholes and used continuously on pressures above 2,000 volts without the protection of a lead sheath to keep out the moisture.

W. Boardman Reed, New York city, called attention to the necessity of giving particular attention in laying duct systems to secure good alignment and a smooth interior.

Mr. Winsor stated that he had had a great deal of trouble with return current on the lead sheath and had a cable burn out and it would turn up in neighboring ducts, and ducts some distance away, the heavy return currents burning the leads out at bonds where they touched and had a good ground. This was so serious that in almost all cases now he cuts a lead sheath an inch or two off each side where it enters—breaks the continuity of the lead sheath.

Regarding cable testing H. W. Latey, New York, said that about the only tests he makes on the direct-current cable is the voltmeter insulation resistance test. He is getting the insulation resistance by means of a 700-volt voltmeter. The high-potential cables, he believes are not tested periodically. He has to test them occasionally on changing connections and in the case of breakdowns, and that is about the only test so far as he knows that the cables are getting.

TUESDAY AFTERNOON SESSION.

President Adams called the meeting to order at 2.30 o'clock, and asked for the first paper, "Relative Economy of Turbines and Engines at Various Percentages

of Rating," by Walter Goodenough, engineering department, Stone & Webster, Boston, Mass.

The author considers that it is becoming evident that what is needed in the power station is not so much more economical prime movers, but rather more intensive operation of the particular type of machinery which may be installed. The author gives a number of tables and a series of curve sheets showing costs per kilowatt-hour and taking into consideration interest, depreciation, maintenance and taxes, cost of engine and generator, condensing apparatus and foundations, cost of turbine, generator, condensing apparatus and foundations, together with motor-generator apparatus and switchboards per kilowatt.

H. W. Latey stated that during the last year Mr. Stott has been making some tests on the Fifty-ninth and Seventy-fourth street plants in New York city, and finds that there is a very marked economy on running on an under load, that is, a 5,000-kilowatt unit operating at considerable underload will operate cheaper than it will on the rated load of the machine; that is, the engines are apparently designed for a fluctuating load, with the engine underloaded rather than overloaded, and it is losing economy, a little bit, on running up on a load that carries a practically steady load as is got in the rush hours at those power-houses.

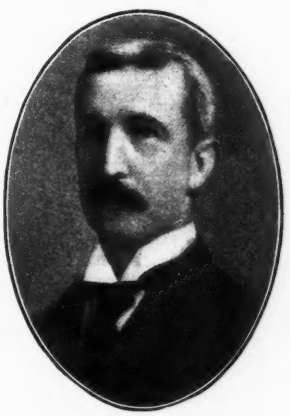
The committee on nominations was appointed, consisting of W. B. Reed, New York; D. F. Carver, Rochester; H. B. Fleming, Chicago; M. O'Brien, St. Louis; and Alfred Green, New York.

The next paper, entitled "Economy in Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, New York, was read.

N. W. Storer said that one of the greatest features in selecting motor equipments for successful operation is to get the right reduction for the motor. There have been thousands of dollars wasted and thousands of equipments given a very bad reputation simply because of the selection of a bad gear ratio. The motors may be geared for entirely too high a speed or they may be too low a speed. A proper study of the conditions was not given before the gear ratio was selected. Suppose a gear ratio is selected which is too high-speed, suppose you select one which is geared for a speed of thirty miles an hour, when your service requirements are such that you only need maximum speed of fifteen or twenty miles an hour. You are going to run your motor at a low voltage practically all the time. He had in mind a road where the motors are operated at an average voltage when the power is on the motors of about only 275 volts while the line voltage will average practically double. That means the motors have their capacity cut in two, and they are operating about half the horse-power capacity which they would have if they were operated more on the high voltage.

WEDNESDAY AFTERNOON SESSION.

The Wednesday afternoon session was called to order by President Adams at



H. H. ADAMS, PRESIDENT AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

2:45. The Question Box was presented and the report from the committee appointed to prepare resolutions in reference to the standardization committee was called for.

Paul Winsor, as chairman, reported for the committee as follows:

"The Committee on Resolutions, to which was referred the vote of the Central Electric Association on certain standards, beg leave to offer for your consideration the following Resolution:

"RESOLVED, That the Resolution of the Central Electric Railway Association on the subject of Standard Brake Shoes, Journal Boxes, etc., dated September 27, 1906, be referred to the Standardization Committee, with the request that that committee submit as soon as possible to the members of this Association their report on these subjects, in whole or in part, so that the members may anticipate what the standards will finally be."

Upon motion of Mr. Simmons the resolution was unanimously adopted.

Mr. Simmons offered the following resolution:

"RESOLVED, That The American Street and Interurban Railway Engineering Association at this time extend to The American Street and Interurban Railway Association, and more especially to its president, Hon. W. Caryl Ely, its thanks for the great amount of sympathy, assistance and encouragement given in the reorganization proceedings during the past year," which was unanimously adopted.

Mr. Evans moved a vote of thanks to Henry Wallerstedt, commending him for his work on the "Standardization Committee," which was unanimously adopted.

Mr. Olds paid an eloquent tribute to the great zeal which President Adams had shown and moved a hearty vote of thanks to him and his associates, which was given with good will. Mr. Adams responded briefly and gracefully.

The report of the committee on nominations was then presented as follows:

President, H. H. Adams, superintendent of shops, the United Railways and Electric Company, Baltimore, Md.

First vice-president, Fred G. Simmons, superintendent construction and maintenance of way, the Milwaukee Electric Railway and Light Company, Milwaukee, Wis.

Second vice-president, J. S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York.

Third vice-president, Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.

Secretary and treasurer, S. Walter Mower, general manager, Southwestern Traction Company, London, Canada.

Members of the Executive Committee, Officers and F. H. Lincoln, assistant general manager, Philadelphia Rapid Transit Company, Philadelphia, Pa.; Fred N. Bushnell, chief engineer, the Rhode Island Company, Providence, Rhode Island; W. T. Dengan, engineer, maintenance of way, New York; H. B. Fleming, chief engineer, Chicago City Railway Company, Chicago, Ill.

Alfred Reed was instructed to cast the ballot.

The convention adjourned *sine die*.

American Street and Interurban Railway Association.

The president, Hon. W. Caryl Ely, Buffalo, N. Y., called the convention of the American Street and Interurban Railway Association to order on Wednesday morning at 10.45 o'clock, introducing the Hon. Lewis C. Laylin, Secretary of State, who extended a welcome to the state of Ohio.

Mr. Laylin said that Ohio is perhaps among the very foremost in development of electric railway lines. Something over a hundred companies have made reports for the year 1896, where the authorized capitalization was over $171,000,000, with a subscribed capital of over $151,000,000, with a mileage of over 3,100 miles and gross receipts aggregating something over $23,000,000.

Robert Sheldon, president of the Columbus Railway and Light Company, was then introduced.

Mr. Sheldon said that the last year his company operated with horses it carried between six and seven millions of people, with gross receipts of something less than $400,000. Fourteen years ago, at the time of electrification, and not stopping

to mention the intervening years to 1898, it reached fifteen millions of people with a gross of nearly $700,000. Last year it carried fifty millions of people, and this year will carry fifty-five millions with gross receipts of approximately $1,600,000.

The Hon. Dewitt C. Badger, mayor of the city of Columbus, was then introduced.

Mayor Badger welcomed the delegates to the city, commenting upon the great strides made in electric traction development and the part it had played in building up the state of Ohio.

John Y. Bassell, Secretary of the Columbus Board of Trade, was then introduced, briefly welcoming the delegates and extending a warm invitation to meet again in Columbus.

The secretary, Bernard V. Swenson, then proceeded to read the minutes of the various meetings of the executive committee during the year, outlining the arrangements which had been made for the management of the affairs of the association and the plans for the Columbus convention.

On motion, the report of the executive committee was accepted and filed.

Secretary Swenson presented the report of the secretary, which showed the membership to be as follows:

October 1, 1906:	
Associate members	113
Active members, old	145
Active members, new	55
	200
Joined since October 1	23
Old companies paid dues since October 1.	5
	228

The report of the treasurer showed the following financial transactions during the year:

Cash on hand and balance from last year and receipts during 1905-1906	$25,444.11
Expenses	18,467.21
Balance	$6,976.90

On motion, the reports of the secretary-treasurer were approved and filed.

President Ely addressed the convention, saying in part:

Gentlemen of the convention and members of the allied organizations—I am standing here before you to address you in the capacity of president for the last time. Three years ago at Saratoga you all remember the condition into which the affairs of the association had drifted by some chance, and it transpired that I was flung into the breach. There were many men who had given careful thought to the affairs of the association, and its condition at that time was apparent to all. We were in fact a social organization, with some business, which we transacted in a certain desultory fashion. The organization had done a lot of good work, but its work was failing because of certain conditions inherent to a situation that had grown up. It was in the first place an organization dedicated to a business that was small, and that was based on conditions that had been outgrown, when a few individuals were largely the owners of the street railways. But there had come into the business a tremendous accretion caused by the electrification of street railways in the cities and the construction of great lines of arteries of interurban traffic, so that where a few millions had been represented in the business, billions of dollars had actually come to be represented, and instead of men for the most part of a moderate degree of ability there had come into the profession thousands of men of the finest ability possible for money to obtain.

Now, is it worth $600 for the largest companies in the United States to belong to this association and is it worth to the other companies, as you come along down the scales, graduating them by their gross earnings the various sums that they respectively pay toward this organization? I think that is a fair question, and every man is entitled to be "from Missouri" and to be shown. It is impossible for the executive committee or the officers of the association to show to any one a chain of $600 in nickels actually going into the treasury of the company—that is an impossibility; or the amount of money that any one pays in. But to the work of the past year I invite your careful attention. It is impossible for me to more than outline it to you, but in the printed bulletins which have been sent to you from time to time in the reports, circulars and letters of the various committees and the data sheets, which have been distributed by them, asking for information in order that they might view the actual facts, and in the programme of this convention and the work that is going as you have seen it in the manufacturers' association and its splendid exhibit that has been put up here so far away from the homes of the manufacturers, in this, the largest attendance that I have ever seen at the opening session of our convention, and in the committee rooms, wherein our affiliated organizations since Monday morning have been carefully and systematically carrying on lines of work that are parallel, though well defined, to the lines of work of this organization and all dove-tailing together and working comprehensively together—in all these evidences it seems to me is proof of the value of the work accomplished through the money that has been expended in bringing about the reorganization. A great corporation that takes in ten, fifteen or twenty million dollars can afford to hire the best technical men and bring to its aid the best ability in every line of this work of ours; that is to say, those companies are justified in an attempt to get the best, but when you think you hire the best it takes time to prove whether you have done it or not; and, suppose it were possible to conceive of an organization wherein all the men were the best, or almost the best in their respective lines of work, then you would have the very best organization that it would be possible for a single corporation to bring to its assistance. But then it would be limited to a very few men compared to all the thousands that throughout this land and throughout this continent—because our representatives come from all over it—are carrying on the different branches of business. Then, in addition to that point, which possibly I should clarify, my idea is that organization, even in that part where men are hired to do certain lines of work, is helpful in many ways, because all the thousands get together in these conventions, and through this line of work as it is now proposed to carry it on, all standing shoulder to shoulder, each one helps the other. In the technical branch of the business a corporation is best able to fortify itself by paying handsome salaries and getting good men, but there are other things in which the large corporations are more vulnerable than the small corporations. The corporations of the great cities are reached far more quickly by the accidents of time and the changes in conditions than are companies in the smaller cities and interurban districts, and when you come to the last final analysis the security of the rights under which these corporations transact their business finally rests upon an honest and fair sentiment actuating the minds of the whole people, and no line of work can be carried on to greater advantage by this great organization than in proper ways, well revised and well calculated, to educate the people of the country to a just and thoughtful conception of the rights of corporations, not only for themselves, but as they touch the people, and also of the business conditions under which they operate. I fancy that there is not a man to-day who is well read and well informed in this business who doubts for a moment the right of the people of any community to take over in a fair way and operate the public utilities, any of them, through their municipalities or other territorial domain. As a matter of right it is undoubted. Then it is up to you to say to the people that as a business proposition it is unwise for the municipalities to attempt to do a business which you are able to establish to the satisfaction of everybody can be done more cheaply for the people by private business interests than by municipal corporations. (Applause.) For years we were afraid to discuss the question. For years we said, "Don't bring it out and talk about it in the convention," and during all those years all the other fellows were talking about it, all the newspapers were spreading what was largely misinformation before the people, and a sentiment was forming against us that, had the people who entertained it had the just and fair means of information, might have been very different from the manifestations that have become apparent within the last few years all over the country.

As has been known for years and so often said, the proof of the pudding is in the eating. A year ago we had a certain number of member companies, and this idea of reorganization was comparatively new, and I wondered, and so did many of the officers, how many we should have left at the end of the year. It gives me great pleasure to say to you in summarizing briefly the report of the secretary and treasurer that whereas last year we actually had paid up at the time of the convention and in good standing less than 187 members—I mean actually paid up and in actual good standing—we have this year 228 member companies and 140 associate members. (Applause.)

President Ely then paid an eloquent tribute to the work of Secretary Swenson and called attention to the hearty way in which the affiliated associations had taken hold of the work of reorganization.

At this point John I. Beggs made a ringing speech in behalf of the officers and executive committees of the five affiliated associations and presented Mr. Ely with a noble bronze statue, mounted upon a marble pedestal, the figure typifying "Triumph." This statue was fitted with a tablet suitably inscribed and was carried in and placed upon the platform by a corps of picked railway employés in uniform. Mr. Ely was visibly affected and briefly thanked all for their token of appreciation and affection.

The presidents of the affiliated associations then made brief addresses, after which the session adjourned.

WEDNESDAY AFTERNOON SESSION.

President Ely called the session to order, and the secretary read several announcements and invitations.

Hon. John I. Beggs, first vice-president, assumed the chair and called for the report of the committee on "Subjects," which was presented by E. G. Connette.

Secretary Swenson then read the report of Committee on Car Wiring.

The next paper on the programme was the report of the Committee on Standard-

ization of Equipment, by H. C. Page, Springfield, Mass., chairman.

W. E. Harrington, New York City, then presented the report of the Committee on Promotion of Traffic.

After considerable discussion a vote of thanks was tendered to the committee for the thorough manner in which they had compiled their report.

The report of the Committee on Insurance was presented by H. J. Davies, Cleveland, Ohio, chairman.

This report reviews the efforts which have been made during the past year to secure a better rating of traction risks, and states in the beginning that the insurance companies, through their inspection and rating bureaus, have, in many cases, somewhat lessened the hazard of fire, and with a slight betterment in the risk conceded a material decrease in premium. Heretofore there has been practically no competition among insurance companies for street railway business. The Factory Mutual Companies compete with stock insurance companies for insurance on "protected" properties—that is property equipped throughout with sprinkling devices that operate automatically upon the occurrence of a fire; or buildings so constructed as to be practically fireproof. But these companies have been unwilling until within about a year to carry insurance even on protected buildings of traction companies. Experiments have been tried during the year at Cleveland, Ohio, and at Newark, N. J., in the presence and under the direction of leading insurance engineers, which have developed apparatus considerably reducing the fire risk and bringing about a condition of willingness on the part of companies in general to write traction risks. The committee reports that a number of street and interurban railway companies in the East and the Middle West are perfecting the organization of a stock insurance company with mutual features, to write insurance upon all classes of traction and lighting company properties. This company is to have a paid-in capital stock and surplus of $1,000,000 in cash. The rates will probably be the same as those charged by the "old line" companies, because this company and the traction mutual companies will have their own inspectors, who, confining their attention to traction and lighting properties, will become experts in their line and will make the insurance rates for their members. All the premium receipts of this company, in excess of fire losses, expenses and six per cent on the capital and surplus of the stock company, are to be returned to the insured. It is the opinion of the committee that all the members of the American Street and Interurban Railway Association may be profitably consolidated into one company, to the extent, at least, of the insurance of their properties against destruction or damage by fire.

This report precipitated a very lively discussion. H. A. Robinson, of New York city, seemed to think that a mutual traction insurance company was an impossible proposition as far as New York state was concerned. Many of the New York properties are covered by large mortgages, in each of which the company making the mortgage has agreed to procure insurance satisfactory to the trustee of the mortgage; and in a number of the leases where the properties of other companies have been taken over—companies which are held by wholly independent stockholders—the holding companies are obliged to give them insurance which is satisfactory to their boards of directors. He did not think it would be possible to get attorneys or officers of trust companies in the state of New York to agree to take insurance for the benefit of $15,000,000 or $20,000,000 of bonds in the policies of mutual insurance companies organized under the laws of Ohio. Owing to the peculiar insurance laws of New York state, which provide against outside insurance except by going through certain formalities before the insurance commissioners at Albany, difficulties would be in the way. It did not seem to him exact protection to bondholders to give them insurance of this character, when it would be necessary for the bondholders to go to the state of Ohio to get the bills paid in the case of a loss. It did not seem to him to be fair treatment of the bondholders to have a contract made for their benefit under the laws of the state of New York.

B. E. Loomis, of New York city, representing twenty-six fire insurance companies which lost about $80,000,000 in the San Francisco conflagration, said that for six years his companies have been carrying on inspection of street railways and power stations throughout the United States. The companies have made it a point to recommend improvements which would reduce the rate. They have cooperated with the Car Wiring Committee, which was appointed some five or six years ago. The Car Wiring Committee was also invited to attend the various tests held by the insurance companies. The insurance companies are more than willing to co-operate with the street railway companies. The National Board of Fire Underwriters would be glad to make an appointment with a representative committee of the Street Railway Association to formulate rules and schedules and to adopt standards of insurance which would be mutually satisfactory to both parties.

Henry N. Staats, of the insurance department of the Cleveland Electric Railway Company, said that he represented twenty-four traction companies in the matter of insurance. In reply to the remarks of Mr. Robinson he stated that the kind of insurance Mr. Robinson had in mind and the kind that the mutual company wished to present were different in character. The kind of insurance he suggested for the "American Street Railway Insurance Company" is a stock insurance with a capital of $500,000 and a surplus of $500,000 before a single policy is issued. That enables the company to enter any state in the Union, and the policies will be made acceptable at any bank or any trust institution. The capital of the company will be subscribed by individuals of the railway companies representing the association. Twenty-four railway companies have already subscribed to the insurance company, and it has been organized under the laws of the state of Ohio. He expressed a lack of faith in the protestations of the insurance companies concerning their cooperation in the matter of better rates. He believed that a cooperation of the traction companies for the purpose of carrying their own insurance would be better than to attempt to cooperate with the "old line" insurance companies and permit them to make their own rules and regulations, and low rates temporarily, which, after competition has ceased, could be put up again.

E. R. Townsend, of Chicago, did not think that the electric light and traction companies could combine to take care of their losses as well as the insurance companies which had a capitalization of over $80,000,000. These insurance companies spread their losses over all the country. They have been making insurance rates of late subject to conditions that the insured shall put in certain improvements which will warrant a reduction in the rates. The elimination of defects and corrections in the electrical equipment and in the physical hazards have produced a high class of properties which has made it possible for the stock companies to make better rates.

A. H. Ford, of New York city, described the difficulties found in effecting mutual insurance in New York state. He showed that where competition had been brought to bear considerably better rates had been made by the "old line" companies, although he would admit that the risks had been very much improved. He thought that Mr. Staats was working in the right direction, but that what he had to give was not adequate. The trustees of the properties would not accept mutual insurance. If Mr. Staats would organize a company with $20,000,000 of capital, he could then talk to him about going into his insurance company. He did not believe that a $1,000,000 company was big enough.

Mr. Davies thought that the suggestion made by Mr. Loomis, to have a representative of the National Board of Fire Underwriters confer with the Insurance Committee, was a good one. The committee does not condemn the stock insurance companies. It wants cooperation for the benefit of the traction companies.

Vice-president Beggs said that he had given a great deal of attention to this matter. He had been for some years in the fire insurance business, and was now in a position to place many millions of fire insurance. The justification for the appointment of the committee was very evident. This is the first time that he had seen one of the "old line" fire insurance companies send representatives to the meeting to say anything to indicate that they cared about the traction business. A few years ago the traction properties were on a prohibitive scale, and, as Mr. Ford said, it was difficult now in certain sections of the country to cover large amounts of insurance. He did not think that a $1,000,000 company would be able to undertake the insurance proposition. He did think that

the association had among its members material for a good strong stock company complying with the laws of the most stringent state of the Union, and had within its ranks the best ability to inspect these risks and to know what would be the proper precautions to make for the success of the undertaking. The association could employ men as good as could any fire insurance company in the United States to conduct its business. It would know what the insurance was costing and would have some guide. He did not think the association could organize a company that would be large enough to carry all the insurance, but thought there was ability in the association to organize a company which would be a guide as to what are the proper charges.

THURSDAY MORNING SESSION.

The Thursday morning session was called to order by President Ely at 10 o'clock. The first order of business was the report of the Committee on Heavy Electric Traction. Calvert Townley, chairman of the committee, presented the report, and said that the steam and trolley roads have so many points in common that it is safe to class them together. He is impressed with the possibility of a development of electric traction whereby the trolley roads, instead of primarily competing with, can become feeders to the steam roads, so that the two classes of transportation will be friendly, and will assist one another. He thought that the committee should be continued as a standing committee, and should take every possible advantage of the experience of steam roads in dealing with the problem of heavy electric traction.

A vote of thanks was extended to this committee for the able and instructive manner in which it had handled the subject.

There being no discussion, the paper entitled "Elevated Railways and Their Bearing on Heavy Electric Traction," by H. M Brinckerhoff, of New York city, was presented.

There being no discussion, the paper entitled "Electric Railways in Sparsely Settled Communities" was presented by E. P. Roberts, of Cleveland. This paper took up in detail the determination of what constitutes a sparsely settled community. the treatment, however, being applicable to any interurban electric railway. Under separate chapter headings the following items were considered: Value of statistics and their proper and improper use; statistics relative to interurban electric railways and discussion of the same; examination relative to an operating or proposed electric railroad; passenger income. Mr Roberts also stated that the value of the promoters or the speculative interest in a proposed electric railway is generally in stock, and as the margin of profit is nearly always quite small, even though the gross income may be large, therefore a quite small percentage difference in the amount of the gross and net receipts may, and frequently will, make such a difference in the amount available for dividends on stock as to practically determine whether or not the stock will have any value. It is therefore very evident that it is impossible to give too much time and expense to the preliminary investigations in order to be sure that the location and design of the road are such as will give maximum dividends, considering the effect of variations of route, first-cost, operating expense, gross income and the net income resulting from the foregoing considerations. It is very easy to affect the gross income from five to fifteen per cent by changes in route or by the character of terminal facilities, and such changes may be accompanied by a greater or less first cost, or a greater or less operating expense, or both.

The paper entitled "Interurban Freight and Express," by E. C. Spring, general manager of the Dayton, Covington & Piqua Traction Company, West Milton, Ohio, was then read. A diversity of opinion exists among the managers of the electric roads whether it is more advantageous to handle merchandise at express or freight rates. Each manager has his own personal opinion and ideas along this line, and in summing up these ideas it is seen that each man's opinion is based upon peculiar circumstances prevalent to his own property. The steam roads of the country have the advantage over the electric lines in this respect, as their conditions are more of a universal or standard nature. The author considers that a determination on the part of the electric lines to follow steam road methods is an excellent one. He would not for a moment recommend any cut below the steam rates for express traffic, particularly between competing points. The electric properties have a chance now in this comparatively new field of service to maintain a standard of rates, and not again experience a condition of affairs the same as has been experienced in the passenger business. The drawing of the line between freight and express business is one which must be decided by the operator. He does not believe that an express service on a short line can be maintained as profitably by the railway company itself as it can be by a regular line express company operating over connecting lines.

After considerable discussion on this subject the paper entitled "Tickets and Rates," by F. W. Coen, secretary and treasurer of the Lake Shore Electric Railway Company, Cleveland, Ohio, was read.

There was no discussion, and the paper entitled "Some Notes on the Evolution of Electric Transportation," by Theodore Stebbins, expert of the National Civic Federation, Cohasset, Mass., was read by title.

The Committee on Nominations, to consist of C. D. Wyman, Massachusetts; G. Tracy Rogers, New York; A. H. Nicoll, Indiana; John A. Beeler, Colorado; E. K. Stewart, Ohio; and on resolutions, consisting of R. E. Danforth, New York; L. D. Mathers, Iowa, and D. A. Hegarty, Arkansas, were appointed.

The meeting was then adjourned.

THURSDAY AFTERNOON SESSION.

The afternoon session was called to order by Vice-President James F. Shaw, of Boston, at 2.30 o'clock. The first order of business was the reading of the paper entitled "Electric Railway Employés and the Young Men's Christian Association," by E. M. Willis, secretary of the International Committee of Young Men's Christian Associations, New York city. Mr. Willis detailed the admirable work which the Young Men's Christian Association is doing among the electric railway employés, and the great interest which is met with in every city where branches have been established. A vote of thanks was tendered to Mr. Willis for his interesting and valuable paper.

The paper entitled "Selection of Trainmen," by C. E. Learned, superintendent of inspection, Boston Elevated Railway Company, Boston, was read.

There being no discussion, the next paper, entitled "Discipline of Train Men," by F. W. Brooks, assistant general manager, Detroit United Railways, Detroit, was read by the secretary.

The paper entitled "Uniforms and Badges," by John R. McGiveney, purchasing agent, New Orleans Railway and Light Company, New Orleans, was then read. This paper described the method of taking care of this problem in the city of New Orleans.

The report of the Committee on Rules was presented by E. G. Connette, chairman. This committee reported that replies received from data sheet No. 11 show that a large number of street railway companies have adopted the standard code of rules approved by the association at its annual convention in St. Louis in 1904. From the replies received, the committee has deemed it advisable to revise the interurban rules which were submitted to the St. Louis convention, so as to conform to the practice of moderate-speed interurban service. The committee submitted for the consideration of the convention a set of rules in pamphlet form for the operation of trains on high-speed electric railroads. These rules conform, as far as practicable, to the rules of the American Railway Association for the operation of steam lines, as the operating conditions of high-speed electric railroads are so nearly identical with the operation of steam railroads that the committee does not believe it wise to depart from steam railroad practice any further than changed conditions necessary for the operation of electric railroads may require. The committee has not made any alterations in the standard code of rules as adopted by the association at its meeting in St. Louis, except in the case of the interurban rules. The report of the Committee on Rules was accepted and the suggestions made by Mr. Connette, that any alterations or additions to the rules that may occur to any of the members of the association be submitted to the Standard Rules Committee for its consideration, and that the committee be continued from year to year until an entirely satisfactory

standard code of rules be secured, were approved.

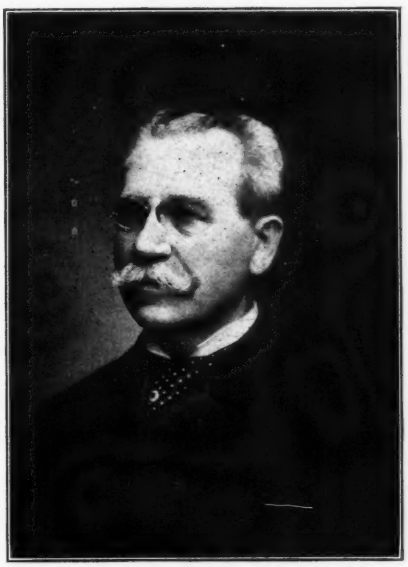
The meeting was then adjourned.

FRIDAY MORNING SESSION.

Vice-President Beggs called the Friday morning meeting to order at 10.30 o'clock in executive session. The report of the Committee on Municipal Ownership was presented by C. D. Wyman, chairman. The report of the Committee on Public Relations was presented by Henry A. Robinson, chairman. Mr. Beggs, who is chairman of the Committee on Compensation for Carrying United States Mail, presented this committee's report.

A paper was presented by John A. Beeler, vice-president and general manager, Denver City Tramway Company, entitled "Handling Public Complaints." Mr. Beeler's paper is made up mostly of incidents relative to the handling of public complaints. Many of these are humorous, but all have some valuable point of interest. Mr. Beeler suggests a printed form for complaints and a method of procedure in handling this part of the street railway manager's routine.

The paper entitled "Leaks Between Passenger and Treasurer" was read by A. H. Stanley, general superintendent, Public Service Corporation of New Jersey. Mr. Stanley thinks that there is an ever-increasing number of the public constantly on the alert to beat the railway company out of a fare, either by evading payment or through unfair use of the transfer. One of the most important features of remedying leaks between the passenger and the treasurer is the creation of a feeling of fair dealing on the part of the public and on the part of the employés toward the corporation. This feeling can be conserved by a satisfactory service better than through any other means. Mr. Stanley suggests that transfers should be carefully inspected in the accountant's office and conductors brought to account for any irregularities either in issuing or receiving. In this way conductors will be more careful, and through them the public will be given to understand that transfers are intended for a continuous ride to their destination only, and not for a stop-over privilege. A daily record should be kept of the condition of the totalizer of each register in every car, whether the car has been in service or not, and sent to the accounting department daily. For this purpose a daily car record blank is recommended. Tickets and transfers should be turned in by conductors each trip. Conductors' day cards and all other reports having to do with the collection and counting of fares should be carefully checked in the accountant's office, and an explanation required for any errors or neglect in making up accounts. Conductors should be made to understand the importance of their reports, and that they must be made up carefully and accurately. Mr. Stanley does not believe that any considerable percentage of newly appointed conductors enter the service with the thought of being deliberately dishonest. What they develop into, whether it be good or bad, is dependent to a very large extent upon the way in which they are trained, their relations with their superiors, and the conditions under which they work.



JOHN I. BEGGS, PRESIDENT AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

W. G. Ross, of Montreal, Canada, in discussing this paper, called attention to the great utility of the "pay-as-you-enter" closed car in use in Montreal. The company has had fifty cars in successful operation, and inside of the next four months will have 100 more. It had effected an increase in the revenue alone of from ten to fifteen per cent. This car is also a great preventative of accidents on the rear platform. The car does away as well with the accounting between the conductor and the company.

A vote of thanks was then tendered to the Montreal Street Railway Company for placing one of these cars on the exhibition grounds for the inspection of the delegates.

The subject was discussed at some length and much valuable information given by Mr. Ross and also by D. McDonald, of Montreal.

The nominating committee presented its report, which was unanimously adopted, and the following officers declared elected:

President—John I. Beggs, Milwaukee.

First vice-president—Calvin G. Goodrich, Minneapolis.

Second vice-president—James F. Shaw, Boston.

Third vice-president—Arthur W. Brady, Anderson, Ind.

Executive committee—The officers and C. L. S. Tingley, president of the Accountants' Association; H. H. Adams, president of the Engineering Association, and S. L. Rhoades, president of the Claim Agents' Association.

Mr. Beggs thanked the association for elevating him to the responsibility of the executive office. He called attention to the necessity for devising some method of improving the attendance at the open sessions of the association. There was not the attention given to the work in hand that it deserved. Particularly should an effort be made to secure good papers.

The Committee on Resolutions then presented its report.

Ernest Gonzenbach was appointed by the new president chairman of a committee to select members to prepare papers for the next meeting.

A. H. Stanley called the attention of the association to the great confusion which prevailed concerning the stopping points for cars in all large cities. He thought that there should be a uniform rule, so that a traveler might know at what side of the street a car would stop, no matter in what town or city he might be. He moved that a committee be appointed to take up the question and report to the association at the next meeting. This motion was carried.

The convention was then adjourned.

The Claim Agents and Accountants also held several important sessions, electing new officers for the year 1906-7. Notice of these sessions will be printed fully later.

American Street and Interurban Railway Manufacturers' Association—The Exhibition of Appliances.

There is hardly any doubt that this convention and exhibition will go down in street railway history as one of the most successful which has ever been held. Not only was there a very large attendance, but the interest manifested at the various sessions of the affiliated organizations was keen, and in the exhibition stalls the comment was frequently heard that a truly representative body of men was in attendance, men to whom it was a pleasure to demonstrate the apparatus upon exhibition, and who, upon their return to their respective home places, were vested with authority to suggest appropriations for the acquisition of more modern appliances. The manufacturers' exhibition was instructional in the highest degree. A great many of the companies made large expenditures for power, so that the apparatus could be seen under service conditions. In many instances also a portion of the housings of valves and other parts was cut away, so that a close inspection of many details was easily possible.

Below are given the names of many of the exhibitors, the names of their representatives and a partial list of the materials on display. In addition to those enumerated below the following representative men were present: H. M. Littell, Frank Betts, F. C. Hinds, N. P. Baker, A. J. Potter, E. F. Peck, Robert Sheldon, C. Loomis Allen, H. F. Schoepf, H. A. Nicholl, T. C. Pen-

ington, Professor F. C. Caldwell, John I. Beggs, Fred Bissell, C. S. Kuntz, Charles F. Scott, J. S. Lapp, Arthur Jones, Frank MacGovern, Jacob Wendell, Jr.; R. L. McDuffie, W. N. Sweeten, Charles F. Johnson, G. C. Knott, W. J. Keenan, F. S. Price and H. E. Eichorn.

Allis-Chalmers Company, Milwaukee, Wis.—As usual, this company was located in a spacious L-shaped booth, providing a large reception room and giving ample space for the placing of various pieces of machinery illustrating electric-railway equipment. A feature of this exhibit was the Christensen air-brake apparatus manufactured by this company. In addition to the standard literature in the form of catalogues and bulletins, there were shown a large number of framed photographs showing typical applications of apparatus made by the company. Represented by F. C. Randall, W. S. Doran, W. W. Power, F. C. Colwell, M. W. Thomas, W. J. Buckley, J. W. Gardner, J. W. Murray, W. T. McCaskey, J. H. Denton, G. Voight, G. B. Foster, W. S. Heger, A. H. Whiteside, H. A. Strauss, H. A. Buell and C. A. Tupper.

American Instrument Company, Philadelphia, Pa.—This company exhibited an attractive line of new "American" voltmeters and ammeters, of both switchboard and portable types. Not only were the railway men interested in these instruments, but considerable attention was given them by the visiting engineers and manufacturers. Represented by James G. Biddle, A. O. Benecke, T. G. Seixas and A. B. Weeks.

American Steel and Wire Company, Chicago, Ill.—The usual jolly crowd was on hand at this company's attractive booth. A feature of the display was a large sign made up of twisted rail-bonds. In addition to this there were fence and trolley wires, cables, rail-bonds and a complete line of rail-bonding tools, including a remarkable new gang-drilling fixture. This company distributed a handsome souvenir in the form of a pressed steel paper-cutter. Represented by George Cragin, C. S.Marshall, F. A. Keyes, C. S. Knight, B. B. Ayers, R. K. Sheppard, J. D. Sutherland, E. Blanchard, George Long, George Chandler, Henry Pratt, Henry Sturdevant, J. M. Holloway and Thomas Lavin.

American Water Softener Company, Philadelphia, Pa.—This company exhibited a model plant showing the method of mixing the chemical solution and elevating the mixture to an automatic tripper and mixer. Represented by W. H. P. Fisher, A. W. Bartlett and A. S. Garrett.

Albert & J. M. Anderson Manufacturing Company, Boston, Mass.—This company exhibited trolley-line material, time switches, and knife switches. Represented by Ernest Woltman, William W. Hincher and J. M. Anderson.

Blake Signal and Manufacturing Company, Boston, Mass.—This company made its usual interesting demonstration of the Blake signal. Represented by E. J. Burke and C. C. Blake.

Brady Brass Company, Jersey City, N. J.—Exhibiting motor bearings. Represented by Daniel M. Brady, George C. Morse, C. M. Reubens and W. F. Kranz.

Harold P. Brown, New York, N. Y.—This veteran exhibited his plastic-bond, solid copper rail-bond, electrical contact alloys, flexible-shaft rail-grinders, high-speed electric rail-drill, magnetic and mechanical rail-clamp, insulated third-rail, and electrical testing laboratory. Represented by Harold P. Brown, F. H. Brown, F. Bissell, R. K. Fast, C. Eccles, J. Hollowood, Julius Alsberg, G. M. Hoadley, Albert Temple, John Roach and J. M. Coote.

Buckeye Engine Company, Salem, Ohio—This company's booth was always attractive and each day a fresh supply of cut flowers was on hand for the decoration of the visitors. In addition to these the company distributed lapel-pin "Buckeyes" as souvenirs. This company exhibited an engine model and framed photographs showing several types of steam and gas engines. Represented by C. H. Weeks, V. T. Price and G. W. Pope.

General Views in the Exhibit Buildings, Street Railway Appliance Exhibition, Columbus, Ohio, October 15-19.

Chase-Shawmut Company, Newburyport, Mass.—Shawmut soldered rail-bonds. Represented by Frank D. Masterson.

Chicago Pneumatic Tool Company, Chicago, Ill.—This company's exhibit was particularly interesting as, in addition to a complete line of pneumatic drills and hammers, there were shown a new 550-volt electric drill, set up with a powerful magnetic rail-clamp. Another interesting feature was a mechanical rail-clamp so arranged as to allow the electric drill to point straight down or normal to the slope of the rail web. Represented by J. W. Duntley, W. O. Duntley, C. E. Walker, C. B. Coates and Edward Aplin.

Consolidated Car Heating Company, New York, N. Y.—Electric car heaters, portable vestibule heaters, switches and switchboards. Represented by Cornell S. Hawley, S. B.

Keys, W. S. Hammond, Jr., and F. W. Brownell.

Consolidated Engine Stop Company, New York, N. Y.—Monarch engine stop, showing method of operating, Monarch testing system, and automatic push-button control. Represented by Arnold W. Lenderoth and H. W. Quackenbush.

Crouse-Hinds Company, Syracuse, N. Y.—Imperial arc headlights and combination arc and incandescent headlights, Syracuse changeable incandescent headlights, Norbitt porcelain specialties, condulets, harpoon guy anchors. Represented by A. F. Hills, N. Shute and C. M. Crofoot.

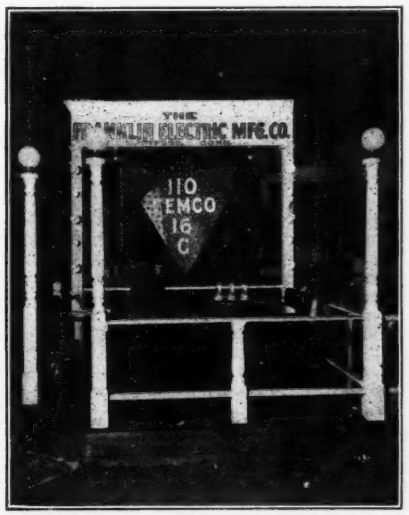
Dearborn Drug and Chemical Works, Chicago, Ill.—With its white and gold embellishments and well-lined shelves, this booth was characteristic of the name. Water-purifying preparations, lubricating oils and greases. Represented by Robert F. Carr, Grant W. Spear, Dan Delaney, Paul T. Payne and W. O. Clark.

Dixon Crucible Company, Jersey City, N. J.—This company made a feature of a huge can, so arranged inside with curvilinear mirrors as to give the visitor an idea of how one looks when "canned." This was a great success. The company also exhibited silica-graphite paints, pipe-joint compounds, American graphite pencils, commutator lubricants, Ticonderoga flake graphite lubricants, graphite greases, plumbago crucibles, foundry facings, motor brushes, and distributed as souvenirs graphite pencils and miniature tin cans, with thimbles for the ladies and dice for the gentlemen. Represented by F. R. Brandon, L. H. Snyder, C. H. Spotts and D. M. Howe.

Dossert & Company, New York, N. Y.—A feature of this exhibit was an iron-pipe railing and fence coupled up with the Dossert solderless splice instead of pipe joints. A new device which attracted a good deal of attention was an insulated two-way motor lead. Represented by Harry B. Logan and E. A. Dossert.

Electric Railway Improvement Company, Cleveland, Ohio—This company showed a new complete, portable bond-welding car and grinder, and electrically welded bond. Represented by C. A. Cadle and J. A. Cadle.

Electric Service Supplies Company, Chicago, Ill.—This company carries a tremendous line of apparatus, but its booth was equal to this range. Extending for some distance along one end and one side of the building, this company's headquarters seemed a veritable exhibition by itself. In addition to the display of apparatus, the appointments were very complete and each day a musical entertainment was given the visitors. Some of the material shown were protected rail-bonds, rail-bond compressors, Keystone overhead insulators, Lyon sheet-steel gear cases, Garton-Daniels lightning arresters and "automotoneers," pole brackets and line fittings, third-rail insulators, Keystone vestibule shades and Keystone cable racks, Mayer & Englund telephones, Philadelphia car fenders, testing instruments, sweeper rattan, high-tension malleable pins, linemen's and constructors' tools and portable lamp guards. Represented by C. J. Mayer, A. H. Englund, J. W. Porter, Max A. Berg, J. V. E. Titus, E. R. Mason, W. P. Cosper, G. W. Cox, J. M. Gallagher, Ernest Boehme, W. D. Hamer, Hugh L. Adams, Wm. A. Armstrong, Jr., Frank B. Massey, Henry R. Swartley, Jr., Edward Hammett, Jr., and Robert Montgomery.



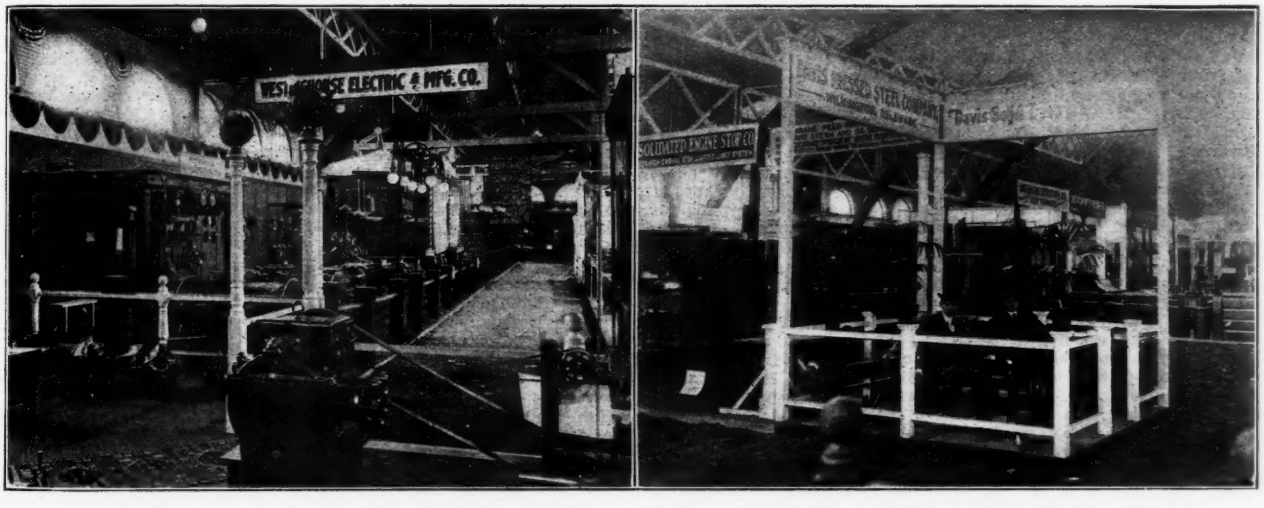
Electric Storage Battery Company, Philadelphia, Pa.—There was the usual "walk-in-and-sit-down" atmosphere about this company's booth, and the representatives on hand found lots to talk about. Two type R cells, one containing eighty-three and the other fifty-five cells were interesting, as were also the carbon regulator, signaling and compensating hydrometers, recording hydrometer and automatic cell filler. Represented by C. Blizard, H. B. Gay and G. H. Atkins.

Franklin Electric Manufacturing Company, Hartford, Ct.—Being distinctly a lamp exhibit, this booth was of particular interest. The Franklin kite made up of blue and white miniature lamps was decidedly effective and a novel offset to the high-powered reflector lamps shown here. But the great feature, however, was a most ingenious device, showing the conditions of vibration to which an incandescent lamp is subjected when a car is under way. This device demonstrated the effectiveness of the new anchored filament lamp which this company has developed for railway service. Represented by P. S. Klees, C. N. Thorpe, C. Leonard and F. E. Wilson.

D. & W. Fuse Company, Providence, R. I.—Deltabeston fireproof magnet wire, enclosed cartridge fuses, enclosed fuse cutouts and fuse boxes. Represented by W. S. Sisson and C. E. Harmon.

General Electric Company, Schenectady, N. Y.—That this company was well represented, both in apparatus and good fellows, goes, of course, without saying. The keynote of this exhibition was instruction. The single-phase system developed by this company was very completely shown, an additional feature being the adaptation of the Sprague-General Electric multiple-unit control system to the single-phase equipment. The CP-21 air compressor was also shown with various parts exposed so as to allow minute examination of the details of this apparatus. For the first time at any convention this company showed its commutating-pole motor for railway use. A large-capacity motor-operated circuit-breaker in combination with a motor-operated main switch, breaking 12,500 amperes at 650 volts was shown. This breaker may be operated at a distance, it being necessary to run only one wire from the switchboard to the point of control. In addition to all this there was a portable air-compressor, mercury arc rectifier and the booth was attractively lighted by 250-watt Gem lamps with Holophane reflectors, and also with the new tantalum lamps. Represented by J. R. Lovejoy, C. C. Peirce, G. D. Rosenthal, H. L. Monroe, R. E. Moore, E. H. Ginn, J. J. Mahoney, H. H. Crowell, E. H. Anderson, C. E. Barry, H. N. Ransom, E. D. Priest, W. G. Carey, F. E. Case, W. J. Hanley, M. M. Corbin, H. H. Corson and Frank H. Gale.

Gold Car Heating and Lighting Company, New York, N. Y.—Single-rod cylinder heaters, two-rod panel heaters, six-rod panel heaters, truss plank heaters, cab heaters, portable house heaters, cylinder heater using junction box connection, cross-seat heater, connected up with iron conduit, no wiring exposed, and display of coils, supporting rods, porce-



General Views in the Exhibit Buildings, Street Railway Appliance Exhibition, Columbus, Ohio, October 15–19.

lains and three-way switches. Represented by A. E. Robbins and F. A. Purdy.

Harrison Safety Boiler Works, Philadelphia, Pa.—Cochrane feed-water heater and feed-water separator. Represented by J. E. Harris.

Heany Fire Proof Wire Company, York, Pa.—Demonstrating heat-resisting qualities of Heany fireproof wire. Represented by W. H. Easton and J. J. Kessler.

H. W. Johns-Manville Company, New York, N. Y.—Overhead line material, third-rail insulators, asbestos, transit doors for transformers, "Noark" enclosed fuses, fuse blocks, service boxes, car heaters, brass goods and trolley-wheels. Represented by J. W. Perry, R. R. Braggins, A. D. Newton, H. M. Voorhis, F. E. Johnson, J. W. Hardy and A. A. Forshee.

Lord Electric Company, Boston, Mass.—Thomas soldered rail-bonds and Shaw non-arcing lightning arresters. Represented by Edwin M. Hamlin, George B. Crane and George W. Smith.

Massachusetts Chemical Company, Walpole, Mass.—This company operates the Walpole Rubber Works and the Walpole Varnish Works. The company had on exhibition samples of "armalac" and special "armalac," No. 50 insulating compound for armature and field-winding, tape No. 264, approved by United States Navy Department, No. 269 waterproof friction tape for outside and mine work, M. C. waterproof paints for exposed surfaces, "Dryfield" tape for street railway motor fields, reinsulating tape for reinsulating old field-coil wire, rubber-splicing compound, and a general line of liquid and rubber insulation. As a souvenir the company distributed a rubber cuspidor mat. Represented by E. C. Green, A. T. Baldwin, R. T. Elwell, L. O. Duclos and A. E. Duclos.

Matthews & Brother, St. Louis, Mo.—Stombaugh guy anchors, Kearney cable clamps, Lima jack-boxes and plugs, O. K. sleet-cutters, "hold-fast" lamp guards, Hargis cable-splicing joints. Represented by Claude L. Matthews and James R. Kearney.

Matthews & Brother, St. Louis, Mo.—Miller guy anchors and ground augurs. Represented by G. H. Miller and F. B. Miller.

National Brake and Electric Company, Milwaukee, Wis.—This exhibit was especially complete and was rendered doubly attractive by the constant operation of the apparatus. The new National air-compressor was shown in full operation with part of the housing cut away to allow of close inspection and examination. The new type N oil pneumatic governor was also shown in operation and there was also shown a new engineer's valve which permits of 150,000 movements with one oiling. A complete two-car schedule air-brake equipment was shown in full operation, and in addition there was a complete line of repair parts for new types of apparatus as well as parts of formerly made types. The company's new line of type N L motors was shown in sizes from three to forty horse-power. Represented by S. I. Wailes, R. P. Tell, W. L. Waters, Griffith Johnson, J. T. Cunningham, C. N. Leet, Bert Aikman, W. M. Bisel, H. W. Beattys, Jr., George S. Hastings, J. T. Perry, W. H. Coble, Arthur Jones, R. W. Woodward and R. W. Hutchinson, Jr.

Novelty Incandescent Lamp Company, Emporium, Pa.—Elk "new" and Novelty "renewed" incandescent lamps. Represented by R. K. Mickey and A. J. Jackson.

Oleson-Williams Company, Toledo, Ohio—Lightning arresters and fuse boxes for electric railway feeders, transmission lines and motor circuits. Represented by Albert Oleson, W. A. Williams and Charles C. Williams.

Rail Joint Company, New York, N. Y.—This company's booth was centrally located and was headquarters for many of the representative street railway men in attendance. The company showed samples and literature regarding standard T-rail joints of the continuous Weber and Wolhaupter types, girder joints of the continuous and Weber types, insulated joints of the continuous and Weber types and various joints in combination with rail-bonds. Represented by B. M. Barr, E. A. Condit, Jr., D. J. Evans, G. M. Hager and W. T. Smettum.

John A. Roebling's Sons Company, Trenton, N. J..—Rail-bonds, armature and field coils, cables and appliances for installing rail-bonds. In addition there were framed photographs of installations and as a souvenir the company distributed miniature rail bonds. Represented by G. R. Mitchell, H. L. Shippy, J. E. Nolan, J. W. Brooks, W. W. Affleck, W. P. Bowman, A. B. Conover and James Henry.

Speer Carbon Company, St. Mary's, Pa.—Carbon brushes and carbon specialties. Represented by J. S. Speer and G. P. Fryling.

Southern Exchange, New York, N. Y.—Poles, ties and cross-arms. This company distributed a valuable match-box and cigar-cutter as a souvenir. Represented by E. G. Chamberlin.

National Carbon Company, Cleveland, Ohio—Carbon brushes. Represented by N. C. Cotabish, A. G. Summerell, F. D. Kathe and J. F. Kerlin.

Automatic Electric Company, Chicago, Ill.—Complete selector switchboard with six lines connected up. Desk and wall instruments. Model board for manual and automatic interconnection. This service was operated in conjunction with the local lines of the Citizens Telephone Company of Columbus. Represented by E. S. Batchelder.

Standard Paint Company, New York, N. Y.—P. & B. tape and insulation. "Ruberoid" roofing and insulating varnish. As a souvenir this company distributed a handsome match-safe. Represented by H. W. Benedict, John H. Thomas, J. H. Vail, F. P. Barker and H. H. Cowherd.

Standard Varnish Works, New York, N. Y.—Sections of field and armature coils impregnated under vacuum, solid and fluid insulating compounds and insulating varnishes. Represented by J. C. Dolph, L. Robinson, F. A. Elmquist, W. W. Schler and H. B. Chiccote.

J. H. Wagenhorst & Company, Youngstown, Ohio—Electric blue-printing apparatus. Represented by Donald Parsons.

Westinghouse Company, Pittsburg, Pa.—It must have done the hearts of the railway men a deal of good to run amuck in the Westinghouse exhibit. There was a constant come and go, accompanied by the clank and hiss of the apparatus under demonstration. The exhibit for the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company consisted of air brake equipments for all classes of electric traction and a blower outfit for power-houses and the like. The exhibit of the Westinghouse Automatic Air and Steam Coupler Company consisted of a working model of the air and steam coupler. The Westinghouse Electric and Manufacturing Company showed the Westinghouse electro-pneumatic control system, operating two No. 121 motors mounted upon trucks. There was also the usual display of measuring instruments, motors, fans, arc and incandescent lamps, line material and views. The companies were represented as follows: Westinghouse Electric and Manufacturing Company—R. W. Beebe J. A. Brett, R. S. Brown, L. M. Cargo, William Clegg, W. L. Conwell, C. S. Cook, Thomas Cooper, W. Cooper, H. P. Davis, J. L. Davis, G. B. Dusinberre, W. F. Fowler, Guy H. Gibbs, J. J. Gibson, J. R. Gordon, S. J. Keese, S. M. Kintner, J. C. Kyle, W. M. McFarland, H. C. Marsh, C. F. Medbury, W. E. Parker, D. D. Pendleton, T. S. Perkins, C. S. Powell, C. W. Register, F. F. Rohrer, F. H. Shepard, O. T. Smith, G. V. Williams, H. C. Stier, N. W. Storer, T. Varney, J. E. Webster and G. B. Griffin. Westinghouse Air Brake Company—G. W. Baker, W. S. Bartholemew, R. H. Blackall, Robert Burgess, C. W. Cass, H. S. Clark, E. A. Craig, E. A. Dewson, C. R. Ellicott, Joseph R. Ellicott, F. V. Green, A. L. Humphrey, S. D. Hutchins, A. Johnson, John F. Miller, F. N. Nellis, C. J. Olmstead, C. W. Townsend and W. V. Turner. Westinghouse Machine Company—John B. Allen, J. H. Wagenhorst, Edwin Yawger and H. D. Watson. Nernst Lamp Company—James L. Anderson. Representing joint interests, J. C. McQuiston and F. S. Smith.

Western Electric Company, Chicago, Ill.—General railway material and "Electrose" insulating products. The company distributed a handsome pamphlet showing views of its Hawthorne works for the manufacture of power apparatus and heavy material, and as a souvenir distributed a valuable pin tray made from "Electrose" insulation. Represented by Fred R. Babcock, W. L. Stockton, D. C. Guest, E. A. Burrows, F. D. Killion, R. H. Harper, L. T. Milnor, C. A. S. Howlett and H. Walton Heegstra.

Yale & Towne Manufacturing Company, New York, N. Y.—This company exhibited two new types of high-voltage electric hoists, designed especially for operation on street railway power circuits. These may be used where the voltage changes are great and are especially adapted for use in boiler rooms, repair shops and car barns. A twenty-ton chain hoist of the "Triplex" type was also exhibited. Represented by Charles W. Beaver and Harry E. Dickerman.

In addition to the exhibit under cover there was a fine display of rolling stock and complete car equipments upon the tracks of the "Big Four" adjoining the exhibit buildings.

The following manufacturers also made elaborate displays of apparatus and were well represented by corps of attendants:

American Brake-Shoe and Foundry Company, Mahwah, N. J.; American Railway Supply Company, New York, N. Y.; Armstrong Oiler Company, Philadelphia, Pa.; Atlas Railway Supply Company, Chicago, Ill.; American Mason Safety Tread Company, Boston, Mass.; Atha Steel Castings Company, Newark, N. J.; Adams & Westlake Company, Chicago, Ill.; Acme Automatic Street Indicator Company; Bayonet Trolley Harp Company, Springfield, Ohio; J. G. Brill Company, Philadelphia, Pa.; Burnham, Williams & Company, Philadelphia, Pa.; S. F. Bowser & Company, South Bend, Ind.; L. M. Booth Company; Cleveland Frog and Crossing Company, Cleveland, Ohio; Consolidated Car Fender Company, Providence, R. I.; Cook's Railway Appliance Company, Kalamazoo, Mich.; Curtain Supply Company, Chicago, Ill.; Creaghead Engineering Company, Cincinnati, Ohio; Cambria Steel Company, Philadelphia, Pa.; Carnegie Steel Company, Pittsburg, Pa.; Duff Manufacturing Company, Pittsburg, Pa.; Dayton Manufacturing Company, Dayton, Ohio; Duplicate Transfer and Rebate Company, Philadelphia, Pa.; DuQuesne Steel Foundry Company, Pittsburg, Pa.; Dressel Railway Lamp Works, New York, N. Y.; O. M. Edwards Company, Syracuse, N. Y.; Electric Railway Equipment Company, Cincinnati, Ohio; Charles I. Earll, New York, N. Y.; Eclipse Railway Supply Company, Cleveland, Ohio; Franklin Car Heating Company, Syracuse, N. Y.; Felt & Tarrant Manufacturing Company, Chicago, Ill.; Galena Signal Oil Company, Franklin, Pa.; W. R. Garton Company, Chicago, Ill.; Goldschmidt Thermit Company, New York, N. Y.; Globe Ticket Company, Philadelphia, Pa.; Griffin Wheel Company, Chicago, Ill.; General Systems Company, Dayton, Ohio; Hale & Kilburn Manufacturing Company, Philadelphia, Pa.; F. P. Harrison Electric and Manufacturing Company, Incorporated, New York; Albert B. Herrick, Ridgewood, N. J.; Heywood Bros. & Wakefield Company, Wakefield, Mass.; George S. Hastings & Company, Cleveland, Ohio; Helios Manufacturing Company, New York, N. Y.; Indianapolis Switch and Frog Company, Indianapolis, Ind.; Ingersoll Company, Pittsburg, Pa.; International Register Company, Chicago, Ill.; International Sprinkler Company, Philadelphia, Pa.; Kalamazoo Railway Supply Company, Kalamazoo, Mich.; Kinnear Manufacturing Company, Columbus, Ohio; Keystone Brake-Shoe Company, New York, N. Y.; Lagonda Manufacturing Company, Springfield, Ohio; Lorain Steel Company, Philadelphia, Pa.; George W. Lord Company, Philadelphia, Pa.; Lumen Bearing Company, Buffalo, N. Y.; John W. Masury & Son, Brooklyn, N. Y.; Maryland Steel Company, Sparrow's Point, Md.; McGuire-Cummings Manufacturing Company, Chicago, Ill.; National Brake Company, Buffalo, N. Y.; National Lock Washer Company, New-

ark, N. J.; Niles Car and Manufacturing Company, Niles, Ohio; R. D. Nuttall Company, Pittsburg, Pa.; National Car Wheel Company, Pittsburg, Pa.; Ohio Brass Company, Mansfield, Ohio; Ohmer Fare Register Company, Dayton, Ohio; Pantasote Company, New York, N. Y.; Pressed Steel Car Company, Pittsburg, Pa.; Pennsylvania Steel Company, Philadelphia, Pa.; Pittsburg Insulating Company, Pittsburg, Pa.; Quincy, Manchester, Sargent Company, Chicago, Ill.; Recording Fare Register Company, New Haven, Ct.; Joseph T. Ryerson & Son, Chicago, Ill.; Frank Ridlon Company, Boston, Mass.; Sherwin-Williams Company, Cleveland, Ohio; Standard Steel Works, Philadelphia, Pa.; Peter Smith Heater Company, Detroit, Mich.; Security Register and Manufacturing Company, New York, N. Y.; Star Brass Works, Kalamazoo, Mich.; St. Louis Car Company, St. Louis, Mo.; Sterling Varnish Company, Pittsburg, Pa.; The T. H. Symington Company, Baltimore, Md.; Schoen Steel Wheel Company, Philadelphia, Pa.; St. Louis Car Wheel Company, St. Louis, Mo.; Sterling-Meaker Company, Newark, N. J.; Taylor Electric Truck Company, Troy, N. Y.; Trolley Supply Company, Canton, Ohio; United States Metal and Manufacturing Company, New York, N. Y.; United States Engineering Company; W. T. Van Dorn Company, Chicago, Ill.; Van Dorn & Dutton Company, Cleveland, Ohio; Wallace Supply Company, Chicago, Ill.; William Wharton, Jr., & Company, Philadelphia, Pa.; Wheel Truing Brake-Shoe Company, Detroit, Mich.; Wilson Company, Chicago, Ill.

RAILWAY SIGNAL ASSOCIATION.

ANNUAL MEETING HELD AT WASHINGTON, D. C., OCTOBER 16, 17 AND 18.

The tenth annual meeting of the Railway Signal Association was held at the New Willard Hotel, Washington, D. C., October 16-17-18, with President C. H. Morrison, signal engineer of the Erie Railroad, in the chair. Commissioner MacFarland, of the District of Columbia, welcomed the delegates to the city at 10 a. m., October 16, before they went into regular session.

There were two sessions daily. Two hundred and thirty-one delegates were present and 538 persons attended the sessions. The programme, as published in advance notice No. 5, was followed as closely as permissible. However, on account of the importance of many of the subjects, papers and reports were set over to accommodate the convenience of the members, as well as many men prominent in the railroad world who came long distances to participate in the discussions. Every railroad in the United States was represented.

A well-arranged programme of entertainment was provided for the women, ninety being in attendance, and such men who found spare time between sessions. The visit to the Executive Mansion and the reception by the President of 267 of the members on Wednesday afternoon was much enjoyed. A theatre party at the National to witness "The Mountain Climber" by Francis Wilson was much enjoyed by 285 persons on Tuesday evening. The first annual dinner was held at the New Willard on Wednesday evening. There were 300 present. Commissioner MacFarland addressed the delegates and their friends. There were fourteen other speakers.

Fifty firms exhibited apparatus and supplies. Fibre, measuring apparatus, signal appliances and mechanisms of many designs, some in operation; derails, mercury arc rectifiers, crossing alarms, various makes of storage batteries, etc., were included.

"Standard Specifications for Mechanical Interlocking and Material for Construction Work," which was presented by a special committee, was adopted as printed, with slight alterations.

Committee No. 8 presented its report on "General Specifications for All Electric Interlocking." It was received as a progress report and the committee instructed to make recommendations next year.

The report of Committee No. 4, "Installation and Maintenance of Storage Batteries," was accepted as printed in advance notice.

"Specifications for Rubber-Insulated Signal Wire, 600 Volts or Less," which is a report from Committee No. 12, was accepted as printed, with the following exceptions, there being a very interesting discussion on many of the paragraphs:

Paragraph A was corrected to read "and must provide the company's" instead of "manufacturer's."

Same paragraph to read "Tests may also be made upon the finished product," etc.

Paragraph 8 to read "submerged in fresh water at a temperature," etc.

In table of sizes, etc., to read "B. & S. No. 2 test voltage A. C. 10,000" instead of 12,000.

The Special Committee on Interlocking and Block Signals elicited a great deal of good, healthy discussion, which disclosed many new and interesting points on the question of color scheme for night signaling, as well as upon the position of the arm—as to whether it is to be placed in the upper right-hand quadrant, or as now generally applied in the lower quadrant.

Recommendations "that two lights shall be displayed on every high-speed signal" and "that the stop indication shall be given by red lights in a vertical line" were adopted.

The report of Committee No. 11, "Signal Lamps," etc., was accepted and the committee instructed to confer with the lamp manufacturers and make further recommendations next year.

The special committee on "How to Remedy the Effects of Foreign Current on Automatic Block Signals" was accepted as printed and the committee instructed to confer with the various signal companies in an effort to gather more data, and make a further report, with recommendations, next year.

Committee No. 1, "Circuits for Automatic Block Signals for Steam and Electric Roads," made recommendations of specifications for relays, which were adopted with but slight modification. This is a very interesting subject and is always well discussed. This report is thought to be, without exception, the best on record. The specifications will no doubt be used generally on the steam roads.

Dr. William Churchill, of the Corning Glass Works, presented an unusually interesting paper on "The Optics of the Signal Lens." It is a valuable addition to the literature of the association. Dr. Churchill, it will be recalled, presented the paper entitled "The Rowndel Problem" last year, it being widely circulated.

The committee on "What Shall Constitute Cost in Estimate for Installation and Record of Maintenance?" presented a progress report.

Committee No. 3 presented a valuable report on "Circuits for Interlocked Signals," the historical matter being especially good and valuable.

Mr. Francis G. Shaw, of the International Switch and Signal Company, presented a paper entitled, "Devices to Keep Railroad Switches from Becoming Clogged with Snow and Ice." While there was no discourse on this paper on the floor, many inquiries were made into the matter and there was quite a lot of discussion elicited.

The annual meeting for 1907 will be held on the second Monday in October at Milwaukee, Wis.

The election of officers for 1907 resulted as follows:

President—J. A. Peabody, signal engineer Chicago & Northwestern Railway, Chicago.

Senior vice-president—A. H. Reidd, assistant signal engineer, Pennsylvania Railroad, Philadelphia.

Junior vice-president—L. R. Clausen, signal engineer, Chicago, Milwaukee & St. Paul Railway, West Milwaukee, Wis.

Secretary-treasurer—C. C. Rosenberg, consulting signal engineer, Bethlehem, Pa.

These gentlemen, together with the following, comprise the executive committee: H. C. Hope, superintendent Telegraph and Signals, Chicago, St. Paul, Minneapolis & Omaha Railway, St. Paul, Minn.; J. C. Mock, electrical engineer, Detroit River Tunnel Company, Detroit, Mich.; C. H. Morrison, signal engineer, Erie Railroad, Jersey City, N. J.; A. R. Raymer, assistand chief engineer, Pittsburgh & Lake Erie Railroad, Pittsburg, Pa.; H. S. Balliet, engineer of maintenance of way, Grand Central Station and Electric Division, New York City.

The entertainment committee and the committee of arrangements comprised the following—F. P. Patenall, signal engineer, Baltimore & Ohio Railroad, Baltimore, Md.; A. H. Rudd, H. S. Balliet, A. P. Eckert, Safety Insulated Wire and Cable Company, New York; L. Griffith, Federal Railway Signal Company; S. Johnson, Union Switch and Signal Company; J. M. Waldron, signal engineer, Interborough Rapid Transit Company; C. C. Anthony, inspector of signals Pennsylvania Railroad, Philadelphia, and J. W. Young, signal inspector, Erie Railroad, Jersey City, N. J.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

Among the larger central-station companies the practice has been developed of making use of a specific character of stationery for certain of their lighting departments. The New York Edison Company has probably carried out this idea more completely than any of the other public service corporations. The accompanying illustration shows a sheaf of letterheads which are being used by the sign department. For the residence lighting department, the power department, apartment-house department, and, in fact, for every department, there is a carefully selected form of stationery. The paper is a fine bond, and is utilized in the most pleasing colors, such as pale pink, pearl grey and other popular tints. Where this can be afforded it is certainly very effective in promoting in the prospective consumer's mind the feeling that whatever business is under discussion is a personal and pertinent matter between the company and himself.

The Gorham Building

BUSINESS centers change, but the Edison Service is everywhere. When the Gorham building was erected on Fifth Avenue, the Edison service was on the spot ready to give it light, move its elevators, revolve its fans—ready for any service, great or small.

The Edison Home

IT takes nine tailors to make a man, but it takes only two tailors to do the work of nine if they are helped out by an Edison goose. Such a goose keeps hot all the time, and only one goose is required, because it is heated while it works with the Edison current.

An Edison Milk Warmer

TENNYSON says:

"An infant crying in the night,
An infant crying for a light,
And with no language but a cry."

Edison says that if the infant is crying only for a light, an electric light can be turned on by touching a button, but that most infants who cry in the night cry for something more substantial than light, and here again comes in the Edison service to heat the baby's milk with an Edison electric heater so as to reduce its crying to the lowest possible terms.

Edison Light at the Bedside

EUGENE FIELD has written down the gospel of reading in bed sufficiently well to satisfy every one. He deals more with the sort of books to be read in bed, and has said nothing about the light.

The only objection we have ever heard against reading in bed has been due to the badness of the light. Here the Edison Service steps in and provides the ideal bedside light to make reading in bed not only a delight but also harmless.

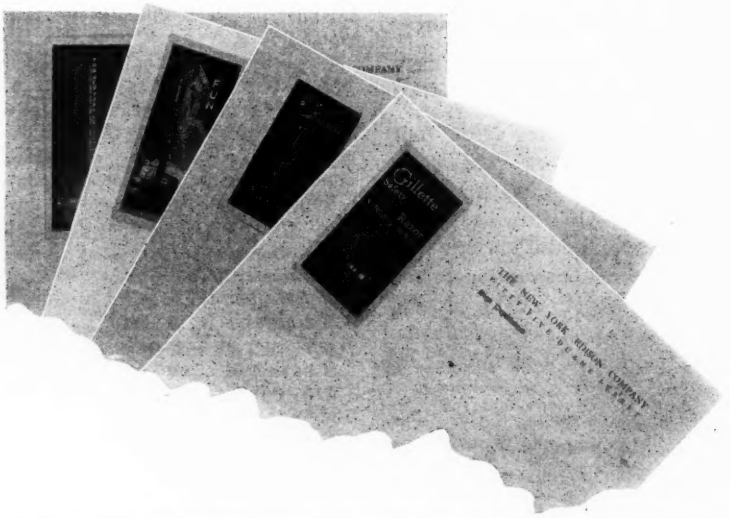
The Edison Service does so many little things so well that we wonder if you know all about all of them. If not, write, telephone or call

The New York Edison Company
55 DUANE STREET

Telephone 3300 Franklin

ONE-COLUMN AD. FROM A DAILY NEWSPAPER.

In addition to the selective character of the stationery, the Edison company makes a very extensive use of literature written especially to interest the particular class of consumer at whom the campaign is aimed, and from time to time use is made of the columns of the daily papers for some effective advertising, the characteristics of even this advertising being the same as those used in the company's direct-by-mail literature. The illustration herewith, taken from one of the daily papers, shows how the "Edison people" are brought to the attention of the reader and the utility of Edison service impressed upon his mind.



SOME LETTER-HEADS USED BY THE SIGN DEPARTMENT OF THE NEW YORK EDISON COMPANY.

Electric Railways in New South Wales.

United States Consul F. W. Goding reports that the number of miles of tramways open in New South Wales on June 30 was 126 and the average cost per mile, including workshops and rolling stock, was $141,576. The percentage of profit to capital invested was $24.71, as compared with $17.11 in the previous year and $9.63 in 1888. The percentage of working expenses to earnings was 78.11, being a reduction of nearly six per cent. The return per average mile open, after paying working expenses, $7.197, the earnings per tram mile $0.25, the working expenses $0.19, leaving a return of $0.05. The number of passengers carried was 145,262,779 and the mileage run 16,309,907.

Test of an Electric Car Brake.

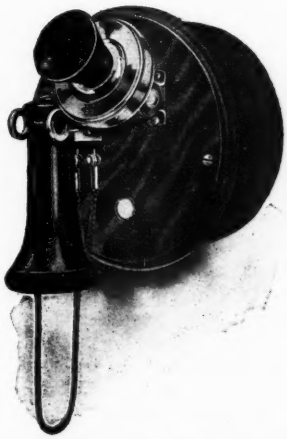
A report has been presented to the town clerk of Halifax, England, dealing with a recent test of an electric car brake on one of the city cars. Trials were made on grades varying from five to nine per cent. With the car running at a speed of sixteen miles per hour it was possible to bring it to a standstill in four seconds without the application of the brake, and within a distance of fifty feet. When running at twenty-one miles an hour it was stopped in 170 feet in ten seconds. When passing over a grade of four and one-half per cent at a speed of twenty-four miles an hour, the car was stopped in sixteen seconds after running 360 feet.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Types of Interior Telephones.

The accompanying illustrations show three new types of interior telephone instruments which have recently been placed on the market by the Holtzer-Cabot Elec-



SINGLE-POINT CIRCULAR FLUSH WALL TELEPHONE.

tric Company, Brookline, Mass., and Chicago, Ill. They are built along lines similar to other standard instruments manufactured by this company, and yet are distinctly new in the combination of the different parts which enter into their make-up.

The single-point circular flush wall

SINGLE-POINT SCHOOL TYPE TELEPHONE.

telephone is designed for use in locations where space is somewhat limited and where an instrument that protrudes from the wall would not be desirable. The working parts are enclosed in a metal case six inches in diameter which sets into the wall, allowing the face of the instrument to rest flush with the wall surface. The transmitter is of the solid back, granular carbon type, mounted on an adjustable bracket so that it may be used by persons of different heights. The receiver is of the standard bi-polar, enclosed terminal type, mounted in a hard-rubber shell. The face of the instrument may be finished in any one of a variety of woods which is best suited to the location where the instrument is to be installed. A flush push button for calling is mounted on the face and if desired a number of buttons may be added so that the instrument can be used in connection with others of a similar nature, making a complete interior telephone system. These instruments can be used in connection with the Ness automatic central, or may be used as branches of a telephone exchange.

The single-point school type of telephone is one of the latest types of tele-

HAND MICROTELEPHONE.

phone instruments brought out by the company. It will be found especially adapted for use in schools, hospitals and similar buildings. The equipment of the instrument is much the same as that of the flush telephone just described. A solid back, granular carbon transmitter is used, mounted on an adjustable bracket, and the receiver is of the bi-polar, enclosed terminal type, in hard-rubber shell. Standard battery telephone bells are used and a flush push button is provided for calling. A feature which has been added to this instrument is that of a chain connecting the receiver cord to the switch hook, so that if the receiver is accidentally left hanging, the contacts are closed and the instrument is connected into circuit. Instruments of this type can be used with good efficiency in connection with a Ness automatic central, or with a telephone annunciator. They may also be used in pairs if desired. The standard finish of these instruments is quartered oak, but they may be made to match the surroundings where they are to be installed.

In the hand microtelephone there is a unique combination of a bi-polar, watch-case receiver and a granular carbon transmitter. The construction is such that when the receiver is held to the ear, the mouthpiece of the transmitter is in proper position for speaking. The handle, which is of hard rubber, contains a push button which throws the batteries in or out of circuit at the will of the operator, thus prolonging the life of the batteries, as they are automatically cut out when the set is not in use. The instrument is solidly and durably built and may be readily taken apart for inspection or adjustment. It is provided with a ring so that it may be hung up out of the way and it is especially adapted for use as a desk instrument in connection with a local telephone exchange or as a branch instrument with the Ness automatic central, and in fact in all capacities in which a portable instrument can be used. These instruments may be provided with a metallic mouthpiece for the transmitter, when used where they will receive hard usage. The instrument is neat in appearance and conveniently light to handle.

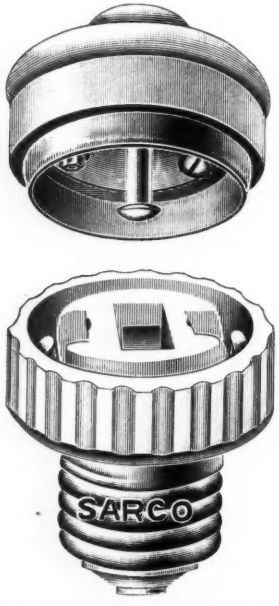
Monthly Dinner of the Boston Edison Company.

The Boston Edison Company, Boston, Mass., held its monthly meeting and dinner on Friday evening, October 12. Van Rensselaer Lansingh, engineer and general manager of the Holophane Glass Company, gave an informal talk on the general principles of illumination, with particular examples of different classes of lighting for residences, stores, etc. Lantern slides were shown illustrating both good and bad features of the lighting of bedrooms, parlors, libraries and kitchens.

The address was followed by a discussion of the features of the latest forms of lamps, such as the tungsten, tantalum, and "Gem," and the necessity of using these lamps in the best possible way, especially with proper and correct reflectors designed for them.

A New Separable Switch Attachment Plug.

An innovation in attachment plugs recently placed on the market by the Sarco Company, 906 Sixth avenue, New York city, is shown in the accompanying illustrations. This is designated as the Sarco swivel separable attachment plug. This attachment plug, in addition to being separable, is also a swivel plug, and, at the same time, will pull apart at any angle.



SEPARABLE ATTACHMENT PLUG—OPEN.

By an ingenious locking device in the bottom part of the plug the top part is gripped firmly, and at the same time has a ball-bearing revolving contact. The heavy circular band in the top part of the plug makes contact with two heavy phosphor-bronze spring contacts in the bottom plug, making one pole; while the centre stud in the top locks into the centre of the bottom plug, thereby giving a very large contact surface.

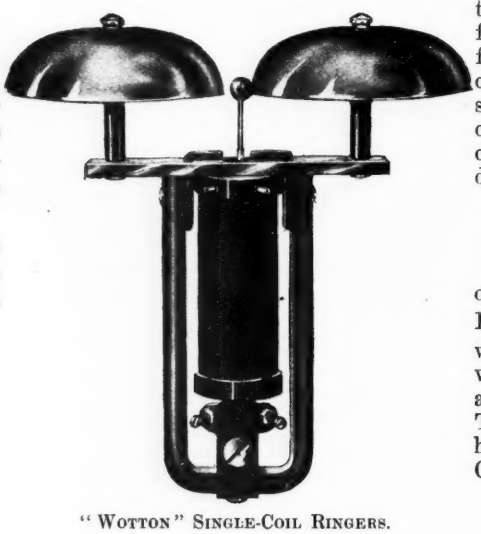
SEPARABLE ATTACHMENT PLUG—CLOSED.

Should the cord attached to the plug become twisted it is not necessary to separate the plug, but simply to revolve the top part, as this part swivels in either direction. If, however, the cord should be accidentally struck or strained, the top part will become separated from the bottom, automatically disconnecting the circuit.

The plug has ample room inside the top part for a knot in the cord, and will take any size of standard re-enforced cord. It may be used to advantage for heating apparatus, motors and massage machines, on account of its heavy carrying capacity, and is also adapted for physicians' appliances, X-ray machines, charging of storage batteries, etc.

"Wotton" Single-Coil Ringers.

The accompanying illustration shows the new "Wotton" single-coil ringer made by the Electric Manufacturing and Equipment Company, Atlanta, Ga. This ringer is the result of exhaustive experimental work covering several years' development of a single-coil ringer and more than six years' successful manufacturing experience in the production of the "Wotton" loud-ringing extension gong, in which the same principles are employed. The company claims great reliability for these ringers because of an improved magnetic circuit and permanent magnets. The coils are wound on insulating tubes, so that grounding of the core is eliminated and a greater sensitiveness ensured. It is stated that this ringer will operate through twenty per cent greater resistance or a condenser of twenty per cent less capacity than the average double-coil ringer of the same resistance. The ringer operates clearly on frequencies from two to sixty-six cycles and can be rung direct from an alternating lighting circuit when desirable.



"WOTTON" SINGLE-COIL RINGERS.

With a total length the same as a double ringer, the width of the mechanism with the single-coil ringer is a little more than half.

Electrical Engineering Department, Columbia University.

The electrical engineering department of Columbia University has secured Ernest S. Holcombe, B.S., '01, Cornell, to take charge of its instrument and standardization laboratory, with the title of lecturer. S. S. Watkins, E.E., Columbia '06, has been secured as assistant in the direct-current laboratory, and C. Otto von Dannenberg, B.E., Union College '06, as assistant in the alternating-current laboratory.

The electrical engineering department of Columbia University is now the official testing laboratory for electricity meters for the city of New York. Complaints from consumers made to the Department of Water Supply, Gas and Electricity are sent to Columbia University, when a test officer immediately makes a test of the complainant's meter and reports to the department.

A Correction.

Through an error in preparing the list of New York installations of the C & C Electric Company in an advertisement which appeared in the ELECTRICAL REVIEW last week, the Hotel Astor was given as one of this company's installations. The electrical installation of this hotel, however, was made by the Western Electric Company.

Special Announcement.

Our readers will be sorry to learn of the partial destruction of the splendid printing establishment of the James Kempster Printing Company, New York city, where for the past twenty years the ELECTRICAL REVIEW has been printed. For sixteen years also this company has printed the transactions of the National Electric Light Association, and for thirty-one years has been printing the stationery of the Western Union and its predecessors. The rapidity with which new facilities were established and the work in hand carried on is worthy of all praise.

Current Electrical News

DOMESTIC AND EXPORT.

LARGE MORTGAGE FILED—The Long Island Consolidated Electrical Companies, a subsidiary concern of the Long Island Railroad Company, has filed a mortgage to the United States Mortgage and Trust Company, of New York city, as trustee, to secure an issue of $10,000,000.

NEW ALABAMA POWER COMPANY—Articles of incorporation have been filed with the probate judge of Montgomery County by the Mussel Shoals Hydroelectric Power Company. The company is capitalized at $1,000,000, and will develop the power of the Tennessee River at Mussel Shoals in Colbert County. The incorporators are New York, Nashville and Montgomery capitalists.

NEW ELECTRIC ROAD—With a capital of $1,000,000, the Hornell, Bath & Lake Keuka Railway Company has been incorporated at Albany, N. Y., to construct an electric road in Steuben and Yates counties forty-six miles long, connecting the Pittsburg, Shawmut & Northern Railroad in Hornell with Jerusalem. The directors are John F. Turk and Charles G. Wheeler, of Hammondsport; Leslie D. Whiting, of Canasteo, and Frederick W. Hastings and Wilson R. Campbell of Bath.

UNITED GAS IMPROVEMENT COMPANY NEGOTIATING FOR SYRACUSE LIGHTING COMPANY—Negotiations are under way which may result in the taking over by the United Gas Improvement Company of the Syracuse Lighting Company. This company owns the Electric Light and Power Company, of Syracuse, N. Y., and the Underground Electric Wire Company, of the same city. In 1902 it acquired a controlling interest in the Syracuse Gas Company, exchanging $1,500,000 of its common stock for an equal number of shares of the gas company. The Syracuse Lighting Company has a capital of $3,000,000 common and $1,000,000 preferred, while its funded debt amounts to $2,165,000.

WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC ROAD TO VOTE ON AN INCREASE IN CAPITAL STOCK—The stockholders of the Washington, Baltimore & Annapolis Electric Railway Company will meet in Annapolis on November 2, to vote on a proposition to increase the capital stock from $4,000,000 to $5,250,000. The new capital will be used in connection with the financing of the Baltimore Terminal Company, which is to furnish an entrance into Baltimore for the line. Arrangements were recently completed in Cleveland for underwriting $1,250,000 of the Baltimore Terminal Company's five per cent first mortgage bonds. It is said that the Washington company will acquire all the stock of the Terminal company.

NEW WASHINGTON RAILWAY AND POWER COMPANY—There have been filed articles of incorporation of the Cowlitz Valley Railway and Power Company, with the principal place of business in Seattle, Wash., and branch offices in Chicago, Ill. The company is capitalized at $5,000,000, divided in $100 shares, and is entitled to construct and operate railways of any motive power, to operate steamboat lines on the Columbia river or any of its tributaries, on the Pacific ocean, and on Puget sound, to develop and operate electric power plants and to engage in mining operations. The trustees, five in number, who hold office until April, 1907, are: Carl Mueller, of Chicago; J. R. Deahl, of Chicago; C. C. Brown, of Castle Rock; C. W. Riddell, of Cascades; H. H. Riddell, of Portland.

ELECTRICAL NOTES FROM MEXICO—The Schoendube & Neugebauer Company has obtained a contract to execute the work necessary to utilize 10,000 litres of water per second, as a maximum, from the Conchos river, in the Iturbide district, in the state of Chihuahua. Aerial or subterranean lines may be used for transmitting electric power. Within twenty months from October, 1906, construction of the works must begin, and the plant must be completed in seven years. The concessionaires agree to contribute $250 per month to the inspection fund in the Federal treasury. Free importation of the necessary material is allowed for once only, and the capital invested is exempted from all taxation, except stamps, during a term of five years. The concessionaires, or the company they may organize, are authorized to issue shares, bonds and obligations, and to dispose of these. Due compliance with the terms of the contract is guaranteed by a deposit in the National Bank of Mexico of $5,000 in bonds of the consolidated public debt. The usual franchises are granted in addition to the foregoing. An American company has been formed in the state of San Luis Potosi for the purpose of using the Tamasopa falls in that state for the development of power. It is understood that engineers have practically completed all the preliminary work and that operations for harnessing the falls will be begun at once.

ELECTRIC RAILWAYS.

MARYSVILLE, CAL.—The Northern Electric Company is to erect a substation at Marysville.

BRYAN, TEX.—The trolley line from Bryan to the Agricultural and Mechanical College is now assured, the full required amount of $15,000 to be subscribed by the people of Bryan having been raised.

GALLIPOLIS, OHIO—The city council has granted M. K. Duty, of Pennsboro, W. Va., a twenty-five-year franchise to construct and operate an electric street railway in Gallipolis. The preliminary survey has already been made.

SAULT STE. MARIE, MICH.—Street cars will be running between this city and the suburb of Algonquin by the first of December, it is announced by the Trans-St. Mary's Company. Construction work on the extension of the line will be started shortly.

WILKESBARRE, PA.—Plans have been arranged by the Wilkesbarre & Wyoming Valley Traction Company to expend $500,000, in order to extend the Georgetown line to Georgetown, the Sugar Notch line to Warrior Run and to make other improvements.

TRINIDAD, COLO.—The Trinidad electric street railway contemplates an extension of its lines. Frank P. Read, the president, states that the company will build to Berwind, Stonewall, Aguilar and perhaps to Walsenburg, tapping the various camps en route.

SHELBYVILLE, MO.—The Shelby County Railway Company has been incorporated to build a road from Shelbina to Shelbyville. The officers are: president, W. C. Blackburn; vice-president, M. S. Smith; secretary and treasurer, L. G. Scofield. Work will commence immediately.

ATLANTA, GA.—The proposition known as "workingmen's fares," or a three-cent rate for certain hours, is being considered by the Georgia Railway and Electric Company for its trolley lines in this city. Steps are also being taken for the enlargement and improvement of the service.

LAFAYETTE, IND.—The board of county commissioners has given to the Lafayette & Hoopeston Interurban Railway Company a franchise to construct and operate an electric railroad through Tippecanoe county from the west town line of West Lafayette to Otterbein, the grant being for a period of fifty years.

RED BLUFF, CAL.—W. D. Nicholson, locating engineer for the Shasta Southern electric road, has intimated that when the proposed first section of the electric road is completed between Hamilton City and Red Bluff the company will build a branch road from Corning to tap the fertile Paskenta section, some twenty miles west, along the foothills.

HUNTINGTON, L. I.—As a result of the trolley franchise hearing, in the matter of the application of the Huntington Railroad Company to extend its line from Huntington to Amityville, it was resolved that the highway commissioners of the town of Huntington prepare the draft of a proposed franchise to be submitted to the applicants for their acceptance.

NORWICH, CT.—At a meeting of the incorporators of the Lebanon Street Railway Company the following directors were chosen: N. C. Barker, F. B. Fowler, L. E. Livermore, G. H. Hewitt, Isaac Gillette, S. W. Troop, J. Henry King, John Clark and L. R. Smith. At a subsequent meeting the directors chose officers as follows: president, J. E. Livermore, of Lebanon; secretary and treasurer, L. R. Smith, of Lebanon; attorney, C. W. Comstock, of Norwich. The company voted to accept the charter which was granted by the

last legislature. The financing of the project will be looked after at once. It is believed the eleven miles of road can be built for $250,000.

COLUMBUS, OHIO—It is reported that J. A. Vandegrift, C. H. Paist and W. C. Neuhaus, of Philadelphia, have concluded negotiations for the purpose of the traction line between Delaware and Magnetic Springs. It is stated that they propose to extend it to connect La Rue with the Lima, Kenton & Marion electric line. At a meeting of the Lima, Kenton & Marion stockholders, the capital stock of the company was increased from $100,000 to $1,000,000.

CARTHAGE, MO.—Promoter Rawlins of the proposed Missouri-Kansas electric railroad, states that work will positively begin on the system shortly, and that it will be pushed through to completion as rapidly as possible. He says that $25,000 worth of material is already in transit and will soon be on the ground. The proposed road will be 150 miles long. It starts at Carthage, runs through the lead and zinc mining districts of southwest Missouri, the coal, gas and oil fields of Kansas, and terminates at Coffeyville.

KENTON, OHIO—The organization of the Columbus, Magnetic Springs & Northern Traction Company has been completed. The following are the first officers: president, W. S. Galbraith, of Pitts burg; secretary and assistant treasurer, W. N. Embert, of Baltimore; treasurer, C. Magee, of Pennsylvania; board of directors, W. S. Galbraith, W. N. Embert, C. Magee, Jr., J. H. Leonard, of Larue, and J. S. Horn, of Richwood. The company will incorporate at $400,000, buy the Magnetic Springs & Delaware line and extend it to Larue *via* Richwood.

POTTSVILLE, PA.—The Eastern Pennsylvania Railway Company and the General Utilities Company, which corporations have bought up all the trolley lines and electric light plants in this part of the state, are to make extensive improvements. The power-house at Palo Alto is to be equipped for furnishing heat and light, and the Pottsville plant is to be abandoned. Another large power-house will be erected at Tamaqua. The current from that place will be supplied for the upper section of Schuylkill, while the Palo Alto power-house will supply the lower county.

KUTZTOWN, PA.—The Allentown & Reading Traction Company will inaugurate a new system for supplying power to its line between Kutztown and Allentown. At present the company has two power-houses, one located near Allentown, which furnishes power from Allentown to Breinigsville. The other is located here and furnishes power from Kutztown to Temple and from Kutztown to Breinigsville. The company has decided to do away with the Allentown power-house and to install sufficient additional machinery in the Kutztown plant to operate the entire system.

OMAHA, NEB.— F. N. Clarke, treasurer of the Omaha Commercial Club, has been authorized to go to New York with William J. Dobbs, of Tabor, Iowa, president of the proposed Council Bluffs, Tabor & Southern Electric Railway Company, to enlist $2,000,000 capital in financing the enterprise. The line for the road has been fully surveyed, the plans prepared and everything ready for to begin work when the money is available. The proposed road will extend from Council Bluffs to Tarkio, Mo., a distance of seventy-six miles, passing through half a dozen towns in the choicest grain and fruit district of southwestern Iowa and northwestern Missouri. It has been demonstrated satisfactorily to the Commercial Club that the road would add 43,000 people to Omaha's population.

NEW HAVEN, CT.—The important work which has been planned by the Connecticut Railway and Lighting Company for its electrical plants in the Housatonic and Naugatuck valleys is taken by local capitalists to indicate that there is no prospect of the company's being sold out to the Consolidated Railway Company. This new work covers an outlay of $750,000 for a new dam about twelve miles below Bull's Bridge dam on the Housatonic river, and also a similar outlay for a steam generating plant at Waterbury, to be used in case of breakdowns. Besides this, the lighting company is working steadily to finish its line of trolley road from Waterbury to connect its lines down from Naugatuck to Ansonia, on the east side of the Naugatuck river. This line will parallel the new double tracking of the New Haven steam road between the same points on the west bank of that river. The Waterbury generating plant will be built at once.

TELEPHONE AND TELEGRAPH.

PONTIAC, MICH.—The rebuilding of the Michigan State Telephone Company's system will be completed by November 15.

LEAVENWORTH, KAN.—R. B. Yoakum has been awarded the contract for the new building of the People's Home Telephone Company. His bid was $14,000.

SPOKANE, WASH.—Representatives of the Pacific Telegraph and Telephone Company state that the concern has set aside more than $125,000 for the development of the field in central Washington.

ALBANY, N. Y.—Negotiations have been completed by the United States Message Company for the taking over of the Commercial Union Telephone Company, which operates in Troy and surrounding towns.

SPOKANE, WASH.—Ten thousand eight hundred telephones are in operation in Spokane under the direction of the Pacific States Telegraph and Telephone Company. This is an increase of 1,200 over three months ago.

PHILADELPHIA, PA.—The American Telephone and Telegraph Company has leased for a term of ten years, from February 1 of next year, the entire seventh floor of the Bourse. The rental will be at the rate of $15,000 a year.

SPOKANE, WASH.—C. L. Wilson, solicitor for the Pacific States Telegraph and Telephone Company, is reported to have secured all the farmers' lines in the vicinity of Nez Perce, Ida., southeast of Spokane, and in connection with this it is announced that five other lines will be built this fall.

SPOKANE, WASH.—The Interstate Telephone Company is making progress with its line from Post Falls, Ida., to Spokane, and it will probably be in operation before the end of the year. It is announced that no rural telephones are to be installed for the present, but that a majority of the ranchers south of the foothills in Idaho and eastern Washington will be given service the coming year.

SPOKANE, WASH.—Plans have been completed for the headquarters of the Home Telephone Company, in Spokane, to cost $60,000. The structure will be of reenforced concrete, fireproof, and is to be completed in May, 1907. It will have a frontage of seventy-one feet with a depth of 100 feet, height two stories and basement. A substation to cost $5,000 will also be erected in Spokane. An automatic switchboard will be installed on the second floor of the main building.

SPOKANE, WASH.—The capital stock of the Interstate Telephone Company, as already announced, is to be increased to $500,000, which will be used in building extensions. M. A. Phelps, president of the company, announces that already 250 miles of line is in operation and that lines will be built in various parts of Washington, Oregon and Idaho. An exchange is to be established in Spokane, which will probably be headquarters for the company. Mr. Phelps has called a meeting of the stockholders for November 2, when several plans will be discussed.

NEW BEDFORD, MASS.—Important changes, including an increase in the capital stock and a replacement of the present equipment with new, have been decided on by the Automatic Telephone Company, of New Bedford. The adoption of the new system will relieve the company of the obligation of paying the royalties that are now required and will, it is expected, place the company on an improved financial basis. The capital stock, it is understood, will be increased from $100,000 to either $150,000 or $200,000, and the present equipment will be replaced with new to a large extent.

NEW HAVEN, CT.—The new Stamford exchange of the Southern New England Telephone Company has been completed, making one of the most substantial buildings used by the company in the state. The installation of the new common battery switchboard is in progress, and the work on the terminal apparatus is also well advanced. There are 4,500 single wires running into the terminal room, and five cables, each containing 400 pairs of wires, one containing 200 pairs and one fifty pairs. The date for the "cut over" from the old exchange has not been set. The new exchange will, however, be opened as soon as practicable, and will double the telephone facilities in the Stamford district.

PERSONAL MENTION.

MR. C. O. BAKER, the widely known platinum importer and refiner, is also prominent in banking circles, and is a large stockholder and director in the National State Bank of Newark, N. J. Last week Mr. Baker and his wife attended the National Convention of Bankers at St. Louis, to which Mr. Baker was a delegate.

DR. SAMUEL SHELDON, professor of physics and electrical engineering at the Polytechnic Institute, Brooklyn, N. Y., received the honorary degree of doctor of physics from the University of Pennsylvania upon the occasion of the dedication exercises of the university's new engineering building last week. Dr Sheldon has been at the head of the electrical and physical departments of the Polytechnic since 1889.

DR. ANDREW FLEMING WEST has been formally invited to accept the presidency of the Massachusetts Institute of Technology, as the successor of President Pritchett. Dr. West was born in Allegheny, Pa., May 17, 1853. He is a son of the Rev. Nathaniel and Mary Tassey West. He was fitted for college in the private schools of Brooklyn and Philadelphia, and entered Princeton in 1870, taking the regular four-year classical course and graduating in 1874 with the degree of bachelor of arts. At Princeton he gained special distinction in Latin and Greek. He was appointed to the chair of Latin at Princeton in 1883, and in 1901 he became dean of the Graduate School. Dr. West is a prolific writer on educational topics, and has been honored by a number of institutions, including his own, with honorary degrees. In 1883 he received the degree of doctor of philosophy from Princeton; in 1897, doctor of laws from Lafayette, and in 1902, doctor of literature from the University of Oxford, England. He was president of the American Philological Association 1901-1902, and has been chairman of the American School of Classical Studies at Rome. He was married on May 9, 1889, to Lucy Marshall Fitz Randolph.

NEW PUBLICATIONS.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS—The proceedings of the annual meeting of the Association of Railway Telegraph Superintendents, held at Denver, Col., June 20 and 21, have been printed. The volume includes also the constitution, by-laws and list of members.

PUBLIC LECTURES, DEPARTMENT OF EDUCATION, NEW YORK CITY—The department of education of the city of New York has prepared a prospectus giving the subjects of various public lectures, and dates and places where they will be delivered, for the season of 1906-1907. Henry M. Leipziger, Ph.D., is supervisor of lectures.

RESISTANCE OF TUBES TO COLLAPSE—The engineering experiment station of the University of Illinois has issued bulletin No. 5, dealing with the resistance of tubes to collapse. This gives the results of some elaborate experiments by Dr. A. B. Carman, professor of physics, and Maurice L. Carr, on the resistance of thin brass tubes to collapse.

AN EFFICIENCY METER FOR INCANDESCENT LAMPS—An article describing an efficiency meter for electric incandescent lamps, contributed to a recent issue of the *Bulletin of the Bureau of Standards* by E. P. Hyde and H. B. Brooks, has been reprinted in pamphlet form. This describes an apparatus arranged to give direct readings of incandescent lamp performance.

ELECTRICAL SECURITIES.

The market, which for four days of the week was dull and with slowly sagging movements, was changed on Friday to a more or less demoralized condition on the news that the Bank of England had raised its discount rate to six per cent. This is an unusually high level and one in force only in times of emergency. The effect of this was shown in the rise in the home money market, the call rates going to seven per cent, with foreign exchange also moving up. The announcement of the new dividend for Amalgamated Copper, putting the annual dividend on an eight per cent basis, failed to effect a rally, and this was looked upon as an ominous factor. However, industrial and business conditions are held to be much too sound and prosperous to permit any extensive price break. Railroad earnings, the iron and steel trade, bank clearings and all other immediate data reflect continued commercial prosperity, and will very likely prove a decided market mainstay.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 20.

New York:	*Closing.*
Allis-Chalmers common	16⅝
Allis-Chalmers preferred	43
Brooklyn Rapid Transit	76⅞
Consolidated Gas	138
General Electric	175
Interborough-Metropolitan common	36⅛
Interborough-Metropolitan preferred	75⅝
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	71¼
Mackay Companies (Postal Telegraph and Cables) preferred	70
Manhattan Elevated	142
Metropolitan Street Railway	107
New York & New Jersey Telephone	125
Western Union	86
Westinghouse Manufacturing Company	154

The formal notice of the special meeting of General Electric stock holders, to be held November 20 in Schenectady, N. Y., has been issued, the object of the meeting being to authorize the increase of $20,000,000 in the capital stock recommended by the board of directors. Secretary Ely, of the New York Stock Exchange, has been notified of the proposed increase in the capital stock of the General Electric Company from $60 000,000 to $80,000,000.

Directors of the Western Union Telegraph Company, at a meeting on October 17, reelected all the old officers of the company with the exception that W. E. Atkins was made vice-president of the contracting department. The executive committee has been reduced in number from twelve to nine. On account of a possible defect in advertising the special meeting of the stockholders of the Western Union held on October 10 to authorize an issue of bonds, and on account of the magnitude of interest involved, counsel has advised that another special meeting of the stockholders be called with a view of reenacting the proceedings of the meeting of the tenth. The meeting will be held November 23.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	235
Massachusetts Electric	69½
New England Telephone	129½
Western Telephone and Telegraph preferred	84

The directors of the Edison Electric Illuminating Compony have declared the regular quarterly dividend of 2½ per cent, payable November 1 to stockholders of record October 18.

The American Telephone and Telegraph Company reports the output of instruments for the month of September as follows: gross output, 131,926; returned, 69,660; net output, 62,266. From January 1 to September 30 the net output has been 1,124,579. The total now outstanding is 6,882,837.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	28⅛
United Gas Improvement	89½

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	145
Metropolitan Elevated preferred	66½
National Carbon common	87
National Carbon preferred	119
Union Traction common	——
Union Traction preferred	——

Directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable November 1 to stock of record October 20.

The finance committee of the Metropolitan West Side Elevated Railroad Company has funded its loans of $600,000 for a period of six years in favor of the First National Bank. The company has given its notes for this amount, bearing 5 per cent interest, securing the loan by deposit of extension bonds. A payment of $50,000 is due April 1, 1907, and a like amount every six months until the entire obligation is canceled on October 1, 1912. The Metropolitan, however, has the option of calling any one of the unpaid notes upon giving thirty days' notice.

ELECTRIC LIGHTING.

SHELBY, ILL.—The electric light plant at Tower Hill has been sold to Ross Shride.

ASHTABULA, OHIO—The city council has voted to sell the municipal lighting plant.

CUSHING, TEX.—Messrs. Yother & McCuen will begin work on the light plant as soon as the material arrives.

DAYTON, OHIO—The Dayton Citizens' Electric Company has taken out a building permit for the new power plant which the company will build at Third and Webster streets.

MEETEETSE, WYO.—A company is being formed by capitalists of Meeteetse and Kirwin to erect a large electric power plant at Kirwin to operate the mines at that place and an electric trolley line between the mining camp and Meeteetse.

GREENVILLE, PA.—The plant of the People's Electric Light, Heat and Power Company, including buildings and equipment, is advertised to be sold by the trustees on November 8. Financial difficulties of long standing forced the company to make an assignment several weeks ago.

GRAND FORKS, WASH.—The substation for the West Kootenay Power and Light Company at Grand Forks is now completed. It is fifty-two by fifty-five feet with a switch tower fifty feet high. This substation building has cost $20,000 to build, and the machinery to be installed will cost another $20,000.

HOUGHTON, MICH.—The Tamarack mine has made arrangements to install an electric plant with a capacity of 150 horse-power. The equipment will be put in place probably early next year, as it will not be possible to get the necessary machinery before that time. The building for its accommodation will be provided in the meantime.

BIG RAPIDS, MICH.—The Grand Rapids-Muskegon Water Power and Electric Company has secured the contract for lighting the streets of Big Rapids. They have been in darkness since last spring, when the flood on the Muskegon river tore out the dam which furnished power for W. E. Donley's electric light plant. His contract with the city expired in August.

BURLINGTON, N. J.—The Burlington Electric Light and Power Company has elected the following officers: president, Griffith W. Lewis; Thomas Daniels, treasurer; Theodore F. Ellis, Jr., secretary. Directors, Nathan Haines, G. W. Lewis, Thomas Daniels, George A. Allinson, Theodore F. Ellis, Jr., George W. Anthony, Forrest K. Curl, William J. Fry, James O. Glasgow.

SPOKANE, WASH.—The Spokane County Electric Light and Power Company has been incorporated with these officers: president, D. L. Huntington, Spokane; vice-president, H. L. Bleeker, Spokane; secretary-treasurer and general manager, H. W. Collins, Rockford, with headquarters at Rockford, Wash. The company will furnish light and power to towns in the southeastern part of Spokane county.

CINCINNATI, OHIO—Norman G. Kenan, president of the Union Gas and Electric Company, states that the executive committee of the company has decided to wire free of charge small homes, so that the occupants can use electricity for illumination. This is a plan that Mr. Kenan has had in mind for a long time, but was not able to put it into effect until the Union Gas and Electric Company leased the Cincinnati Gas and Electric Company's property.

NEW ALBANY, IND.—Water power sufficient to generate 1,000 horse-power of electricity is said to be going to waste at the falls in Blue river, near White Cloud, Harrison county, and the feasibility of utilizing the falls, owned by William and Julius Rothrock, of Harrison county, is being investigated. It is asserted that there is sufficient power to operate an electric line between Corydon and the Falls Cities, and also to run all the factories at Corydon and illuminate the streets and houses.

SHAWNEE, OKLA.—The city has authorized the mayor to enter into a contract with the Shawnee Lighting Company for the number of lights now maintained at a rate of $6 per month. Additional lights up to 300 will be installed as fast as the taxable valuation warrants the city in expending the money. About thirty-five new lights will be put in within the next two months. The old rate was $8 per month and the contract recently expired. The new rate will remain in force for eighteen years.

ALBANY, N. Y.—Work on the power-house of the Hudson River Electric Power Company, which will be located along the Mohawk river in Niskayuna, just above Vischer's Ferry, will be started, it is thought, next spring. The power-house will be built of brick and will be similar in size and capacity to the Mechanicsville plant. It is expected that between 6,000 and 7,000 horse-power will be generated. The power will be furnished by seven General Electric turbo-generators of 1,000-horse-power capacity each.

JACKSONVILLE, FLA.—Negotiations which have been pending for several months have been closed, whereby the Jacksonville Electric Company agrees to transfer to the city of Jacksonville its franchise for electric lighting and to retire from further competition with the city plant, thus giving it the exclusive right to furnish electricity to consumers. The Jacksonville Electric Company operates the street railway system, and has been furnishing lights and power to consumers in competition with the municipal plant, doing a business of $60,000 a year.

WAYCROSS, GA.—Mayor Knight will take up with the city council the matter of municipal ownership of the electric lights as soon as it is possible to do so. In the meantime, however, the city has installed an electric light dynamo in the waterworks plant and is furnishing electric lights for the city hall, fire station and the waterworks station. Nearly every member of the present city council favors municipal ownership of lights, but nothing can be done toward installing a plant for public use until the present contract which the city has with the Waycross Electric Light and Power Company expires.

UTICA, N. Y.—W. G. Stone, civil engineer, of this city, has completed plans for the development of a water power at Chenango Forks on the Chenango river for Peters Brothers, of that place, who conduct a large flour mill, saw mill and planing mill. In the spring a modern concrete dam and power-house will be constructed. The dam will be 400 feet long and the power-house will be fifty by seventy feet. The spillway will be about 375 feet long. The dam is designed for a depth of seven feet of water on its crest. A system of compensating reservoirs is included in the general plan. Peters Brothers have made arrangements to dispose of all the power that they can produce in addition to that which they need for their business.

JACKSON, MICH.—At a meeting of the stockholders of the Boyne River Power Company, held at Grand Rapids, the following directors were elected: Amos S. Musselman, S. A. Sears, C. C. Follmer, Frederick C. Miller and E. A. Stowe. At a meeting of the directors held subsequently to the meeting of the stockholders the following officers were elected for the ensuing year: president, E. A. Stowe; vice-president, Amos S. Musselman; secretary, C. C. Follmer; treasurer, Frederick C. Miller. Mr. Miller was elected manager as well as treasurer and has left for Boyne City, where he will open an office and direct the erection of a thirty-three-foot dam across Boyne river, three miles southeast of Boyne City, the power thus generated to be utilized to light Boyne City, Boyne Falls, Clarion and the resorts on Walloon lake.

NIAGARA FALLS, ONTARIO—The Hydroelectric Power Commission of the province has submitted its third report and the following matter bearing upon the Niagara Falls power situation is contained therein: The cost and charges of a secondary transmission line from Berlin through Elmira to Elora conveying power from Niagara Falls on a basis of 750 horse-power are given at: Total investment, $39,952; annual charges, $4,435; cost for twenty-four-hour power, per year, at Berlin substation, $17.36; at Elmira, $24.10; at Elora, $26.56; at Fergus, $29.91. The statistical portion of the report gives detailed estimates of the capital, costs and annual charges of five hydroelectric developments of a total nominal capacity of 9,950 horse-power, and in connection therewith detailed estimates of the capital costs and annual charges, etc., of transmission systems and substations necessary to deliver this power to various municipalities; and also some 3,900 additional horse-power from Niagara Falls to meet a demand for power in localities which it has not been found feasible to supply from water powers of the district.

NEW INCORPORATIONS.

HARRISBURG, PA.—Junction City Electric Company, Rochester. $5,000.

LANSING, MICH.—Onondaga & Eaton Rapids Telephone Company. $3,000.

ST. LOUIS, MO.—Senath Telephone Company, of Dunklin. Capital increased from $1,500 to $6,000.

PIERRE, S. D.—Sioux Falls & Sioux City Electric Railway Company. $1,000,000. To build a sixty-mile line paralleling the St. Paul road.

AUGUSTA, ME.—Patten & Trout Brook Telephone Company, Patten. $3,500. President, B. W. Howe; treasurer, W. S. Kellogg, Patten.

MILWAUKEE, WIS.—The Cashton Telephone Company, village of Cashton, Monroe county. $10,000. Incorporators: Frank E. Steele and Jorgan A. Moen.

WORCESTER, MASS.—The Worcester Electric Contract Company, Worcester. $10,000. President, Roger T. Morris; treasurer, Clarence W. Hobbs, Jr., both of Worcester.

NASHVILLE, TENN.—The Connally-McIlheran Electrical Engineering Company, Hamilton county. $10,000. Incorporators: W. B. Connally, W. C. McIlheran, W. C. McAfee, H. A. Clark and M. M. Allison.

ELGIN, ILL.—North Shore & Western Electric Railway. To operate a road between Elgin and Evanston. $50,000. Incorporators: William C. McHenry, William A. Love, Ernest R. Fifer, of Chicago, and Harry P. Parsons and George P. Merrick, of Evanston.

JEFFERSON CITY, MO.—Missouri Interurban Railway Company. To build a line between Jefferson City and Sedalia. $20,000. Stockholders: J. W. Meller, of Sedalia; W. B. Myers, of Smithton; J. D. Starke, of Soleville; J. H. Gunn, of Otterville; W. B. Kerens and A. W. Nelson, of Bunceton; Henry Fricke, of Prairie Home; F. P. Glendennin, of Cedron; B. W. Lansdown, of Centretown, and C. W. Thomas, of Jefferson City.

HARRISBURG, PA.—Pittsburg & Westmoreland Traction Company; to construct a twelve-mile line from Greensburg to Latrobe; $72,000; Wesley F. Raymond, of Middletown, president; directors, John R. Geyer, E. K. Condran, Charles Hatton, A. R. Geyer, W. E. Raymond, Middletown, and Henry C. Allen, Erie. McDonald & Midway Street Railway Company; to build a three-mile line from McDonald, Washington county, to Midway; $18,000. Burgettstown Street Railway Company; to build a line one and a half miles long through the streets of Burgettstown, Washington county; $9,000.

NEW MANUFACTURING COMPANIES.

HARRISBURG, PA.—The Lindeman Graham Electric and Manufacturing Company has been incorporated with a capital of $10,000. The company's headquarters will be at Pittsburg.

MUSKEGON, MICH.—Articles of incorporation of the West Michigan Electrical Company, of Muskegon, have been filed with the secretary of state at Lansing. The following officers are named: president, F. W. McMeal; secretary and treasurer, W. G. Peacock; vice-president and general manager, R. R. Raney.

BALTIMORE, MD.—For manufacturing and dealing in attachments for telegraph sounders and other patented telegraphic attachments, the Long-Distance Sounder Manufacturing Company has been incorporated with an authorized capital stock of $50,000. The incorporators are: Mortimer W. West, Jane L. West, John F. Mickey, Clarence H. Grumbine and J. Harry C. Sauer.

AKRON, OHIO—A company to manufacture insulators for all kinds of electrical goods has been incorporated at Columbus with a capital stock of $1,000. The company will be known as the Akron High Potential Porcelain Company, and the incorporators are: M. Otis Hower, George H. Kile, Samuel Kile, A. L. Dyke and H. E. Andress. The company will start operations at once, having purchased the plant of the Barberton Pottery Company. The interior of the building has been remodeled and new machinery installed. Officers have not yet been elected.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1053 describes and illustrates railway motors and controllers.

MACHADO & ROLLER, 203 Broadway, New York city, have published a new price list devoted to Whitney electrical measuring instruments.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., is distributing a new series of literature devoted to American "Steel Clad" irons.

THE LORD ELECTRIC COMPANY, Boston, Mass., manufacturer of railway specialties, is presenting to some of its customers a very attractive and handy paper cutter and check stamp. This is one of the most attractive souvenirs that has come to our notice for some time.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its new fixture catalogue No. 25. This catalogue contains ninety-two pages, is handsomely bound, with a color design on the cover, and shows a great variety of new material in decorative electric lighting fixtures. The catalogue is so arranged that information can be readily secured concerning a wide line of this apparatus. The company will be pleased to supply copies to anyone interested.

DUNTON & FIELD, 117 Main street, Cambridge, Mass., have some new literature describing and illustrating the Dunton tree insulator. This insulator can be used on any electric lighting, telephone, telegraph, railroad or fire-alarm wire running through trees. The metal part of the insulator is of malleable iron, and the arm swings on a sleeve which is lag-screwed to the limb of a tree and turns in a cone-shaped casting pivoted to the lower end of the arm. This allows the glass to be placed in a vertical position at all times when tied to the wire.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, has favored this office with complete sets of the direct-by-mail literature which it has been sending to lamp buyers during the past few months. To any manufacturer who is interested in this subject these "Fostoria" booklets and circulars will be found suggestive and interesting, as they indicate possibilities of original work along these lines. The pamphlet "Lamps and the Man" is especially unique in physical appearance and in its literary flavor. In the fore-word to this little brochure the editor says: "'Lamps and the Man' is a 'four-phase' article appearing through the fall and winter with a frequency of about one 'phase' a month. A complete article is also bound into a souvenir booklet which will be furnished upon request. Write for it." The Fostoria direct-by-mail advertising system also comprehends a number of especially unique embossed blotters in various hues, such as would decorate a lady's writing table, and other artistic conceits in circular ideas, both to be mailed in envelopes and also on post cards.

THE CANADIAN WESTINGHOUSE COMPANY, Hamilton, Ontario, has contracted with the Yukon Consolidated Gold Fields Company for the following electrical apparatus, to be used in gold dredging in the Yukon Territory: three 100-horse-power, three-phase, sixty-cycle, 400-volt type F motors; three fifteen-horse-power, three-phase, sixty-cycle, 400-volt type F motors; three fifty-horse-power three-phase, sixty-cycle, 850-revolution, 400-volt, constant-speed induction motors; three thirty-horse-power motors; three twenty-horse-power, 1,120-revolution motors; three fifteen-horse-power, 850-revolution motors; three seven and one-half-horse-power, 1,700-revolution motors; nine seventy-five-kilowatt, oil-insulated, self-cooling transformers; two 625-kilowatt, three-phase, sixty-cycle, 2,200-volt, 415-revolution, alternating-current generators, and two seventeen-kilowatt type S exciters for these generators. The order also includes four panel switchboards for controlling the apparatus; four 250-kilowatt, oil-insulated, oil-cooled transformers, and four 200-kilowatt machines of the same type.

Record of Electrical Patents.

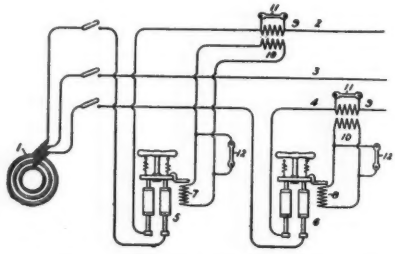
Week of October 9.

833,159. RELAY ATTACHMENT AND ALARM FOR TELEPHONE SYSTEMS. Charles A. England, Van Meter, Iowa. Filed November 13, 1905. Consists of a shell with a hinged cap supported from a pair of vertical arms.

833,169. MAGNETIC ORE SEPARATOR. Camden E. Knowles, Joplin, Mo., assignor of three-fourths to G. B. Young, George T. Cooley and Guy H. Elmore, Joplin, Mo. and W. E. Brinkerhoff, E. O'Keefe and Joseph Herrin, Carthage, Mo. Filed December 5, 1901. The magnetic surfaces converge from the feed to the discharge and terminate abruptly.

833,178. MEANS FOR OPENING AND CLOSING ELECTRICAL CIRCUITS. Gustaf Rennerfelt, Scranton, Pa. Filed June 11, 1904. A system for gradually and automatically closing an electric circuit.

833,194. PROTECTIVE DEVICE FOR ALTERNATING-CURRENT CIRCUITS. Leonard Andrews, Manchester, England, assignor to Stanley-G. I. Electric Manufacturing Company. Filed September 18, 1905. A circuit-breaker actuated when a series transformer becomes saturated magnetically.



833,211. SAFETY SYSTEM FOR HIGH-TENSION TRANSMISSION LINES.

833,211. SAFETY SYSTEM FOR HIGH-TENSION TRANSMISSION LINES. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to General Electric Company. Filed April 20, 1904. The fuse is shunted by an inductance from which leads are taken to the tripping coil.

833,224. RECEIVING DEVICE FOR ELECTRIC TRANSMISSION. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed March 25, 1905. Renewed April 4, 1906. A relay which acts to vary the relative resistances of two air-paths rendered conducting for an electric discharge.

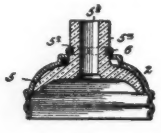
833,225. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed April 14, 1905. Renewed January 18, 1906. A duplex system utilizing high and low frequency current.

833,226. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed June 6, 1906. An all-metallic line operated by grounding at the stations.

833,228. MOTOR CONTROLLER. William A. Lacke, Chicago, Ill. Filed November 29, 1905. An automatic multiple-switch controller.

833,252. COUPLING FOR ELECTRIC CABLES. Charles F. Schwennker, Schenectady, N. Y., assignor to General Electric Company. Filed February 14, 1903. Tapered terminals are clamped together by a helical spring.

833,279. TELEPHONE RECEIVER. Henry F. Albright, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed February 5, 1904. Employs a tubular magnet with a non-magnetic cup, flaring outward from the outer shell.



833,556. INCANDESCENT LAMP SOCKET.

833,290. ELECTRICAL CONDUCTOR. Anson G. Betts, Troy, N. Y. Filed November 30, 1904. A composite conductor of metallic sodium with a reenforcing sheathing.

833,296. JUNCTION BOX. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Construction Company, Utica, N. Y. Filed September 15, 1904. Is provided with openings closed by partially displaced blanks.

833,297. LOCKOUT SYSTEM FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor, by direct and mesne assignments, to the Select Telephone Manufacturing Company, Springfield, Ohio. Filed October 5, 1905. A normally open shunt at each instrument is closed automatically.

833,298. LOCKOUT SYSTEM FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor, by direct and mesne assignment, to the Select Telephone Manufacturing Company, Springfield, Ohio. Filed October 23, 1905. A relay, controlled by the hook, locks out other stations through a grounded line.

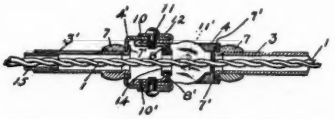
833,312. TROLLEY. Andrew H. Dreijer, New York, N. Y. Filed June 6, 1904. The wheel is centered by two or more rollers carried in the channel.

833,317. CUTOUT. Henry Geisenhöner, Schenectady, N. Y., assignor to General Electric Company. Filed May 8, 1903. A plate holds the contacts in position.

833,337. DISTRIBUTING BOX. Harry H. Hornsby, Chicago, Ill. Filed January 7, 1903. A distributing board with a plurality of openings and leading-in channels.

833,342. ELECTRIC RECEPTACLE. Bert E. Salisbury, Syracuse, N. Y., assignor to Pass & Seymour, Incorporated, Solvay, N. Y. Filed February 20, 1906. Projections are provided for locking the receptacle to a supporting plate.

833,353. TROLLEY-WHEEL. Gustavus Troxler, Jr., Newark, N. J., assignor of one-fifth to himself, one-fifth to Alexander Ober, one-fifth to Robert Neil, one-fifth to Theodore Perry, Newark, N. J., and one-fifth to Arthur H. Moore, Jersey City, N. J. Filed October 10, 1905. Spring-supported radial arms project beyond the edge of the wheel.



833,567. FLEXIBLE JOINT FOR ELECTRIC TUBING.

833,357. ELECTRIC FURNACE. Leonard Waldo, Plainfield, N. J. Filed June 23, 1905. An induction furnace with means for electrolyzing the charge.

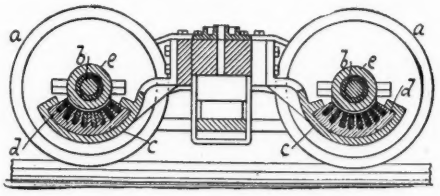
833,361. WAVE AND CURRENT ELECTRICAL GENERATOR. John T. Wilmore, Denver, Col. Filed October 23, 1905. The electric generator is enclosed within a drum which is rotated by the waves.

833,390. SPRING-JACK FOR TELEPHONE SWITCHBOARDS. Howard B. Holmes, Park Ridge, and Edward B. Craft, Chicago, Ill., assignors to Western Electric Company, Chicago, Ill. Filed June 24, 1905. The jacks are mounted on a plate provided with an extended test ring.

833,429. AUTOMATIC SYSTEM OF INTERCOMMUNICATION. Anthony Van Wagenen, Sioux City, Iowa. Filed July 31, 1902. Renewed March 3, 1906. The connections sought are made by means of a service and a switching wire.

833,447. ELECTRIC SIGNAL FOR WEIGHING-SCALES. Stephen J. Derbes, New Orleans, La. Filed November 28, 1905. The movement of the scale beam is indicated by signals.

833,449. TELEPHONE TRANSMITTER. Stanley A. Duvall, Elkhart, Ind. Filed March 5, 1903. A resistance chamber and one electrode are mounted adjustably within a cup.



833,635. ANTI-FRICTION DEVICE.

833,505. TROLLEY. Henry B. Burke, Windber, Pa. Filed December 28, 1905. The wheel is supported on spring arms.

833,556. INCANDESCENT LAMP SOCKET. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed June 5, 1903. An insulating cap is locked within the top of the socket.

833,567. FLEXIBLE JOINT FOR ELECTRIC TUBING. William E. Ward, Bayonne, N. J. Filed December 5, 1905. A coupling of two parts, which are pivoted together.

833,603. SIGNALING ON RAILWAYS. Charles M. Jacobs and Robert J. Insell, Reading, Edward F. Newton, Cardiff, and Ernest A. B. Bowden, Hanwell, England, assignors to the Western Syndicate, Limited, London, England. Filed October 30, 1905. A signal system actuated by the train.

833,635. ANTI-FRICTION DEVICE. J. S. Rogers, New York, N. Y. Filed January 11, 1906. An electromagnetic device for relieving pressure on bearings.

833,689. APPARATUS FOR DUPLICATING PHONOGRAPH RECORDS. Isidor Kitsee, Philadelphia, Pa. Filed April 20, 1901. A stylus bearing on the original record varies the current through an electromagnet which controls the reproducing knife.